Chemical Engineering

SEPTEMBER
1955

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GUIDED TOUR

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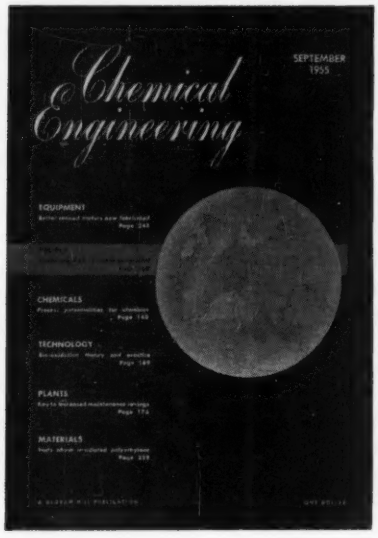

. . . **Here's across-the-board coverage of topics that interest engineers most.**

Want a first-hand summary of what a revitalized chemical engineering profession is accomplishing in Europe today? Don't miss Sid Kirkpatrick's stimulating evaluation. (p. 169) Is bio-oxidation a tool that you can use? It sure is! And this month, in terms understood by chemical engineers, our feature report gives the lowdown on bio-oxidation and how it's applied to plants for treatment of organic wastes. (p. 189)

It's worth money and more to you . . .

. . . to set up and work through a program for your personal development. Here's a practical slant on how to go about it—what to do and what to shun to keep your career on the beam. (p. 163)

Your key to maintenance savings.

Here's the "anatomy" of maintenance—a grouping of jobs by source characteristics. It can help you get off on the right foot to-

Please turn page

Drying Reports on the Way

Next month CE will bring you the first section of a two-part report on drying in the process industries. The two together will be the equivalent of a small book—but a book that will be hot off the griddle—not several years in the making as books usually are.

Walter C. Lapple and William E. Clark, drying experts at Midwest Research Institute, are the authors of the over-all report. For Part II in November, they will be joined by E. C. Dybdal of Monsanto, who is adding a large amount of cost information on the principal types of dryers.

Although the authors have not shied away from the necessary theory, their approach is thoroughly practical. They have set themselves this task: You have a drying problem. How shall you solve it?

To that end they discuss dryer types, how to determine dryer duty for your materials, how to narrow the field of suitable dryers, how to estimate the cost of each type and to find the most likely economic solutions.—JRC

GUIDED TOUR

wards more effective cost control in this rewarding area. (p. 173)

Building something out of graphite?

Interested in graphite as a material of construction? Here is practical information —what to do, what not to do—about building a furnace hearth out of graphite blocks. TVA engineers developed the data (p. 179).

Water, water everywhere: all impure.

Water is the lifeblood of the chemical process industries. And it's always in some impure form whether you use it for processing, cooling, boiling. This month, author Nordell tells you what it contains. (p. 183)

Can you tackle reactor design?

Much of the problem of process development is the problem of reactor design. Starting this month CE Refresher helps you put kinetics to work in the practical design of chemical reactors. (p. 203)

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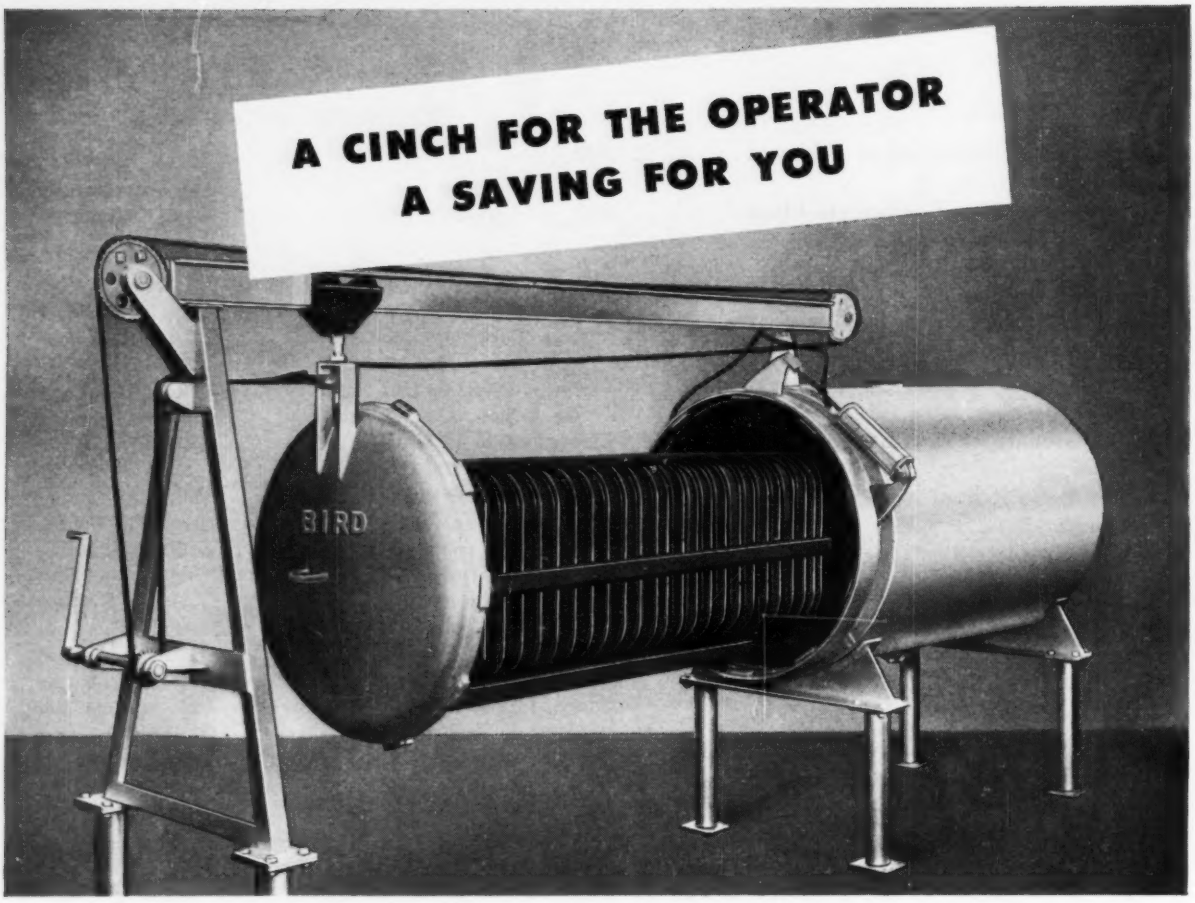

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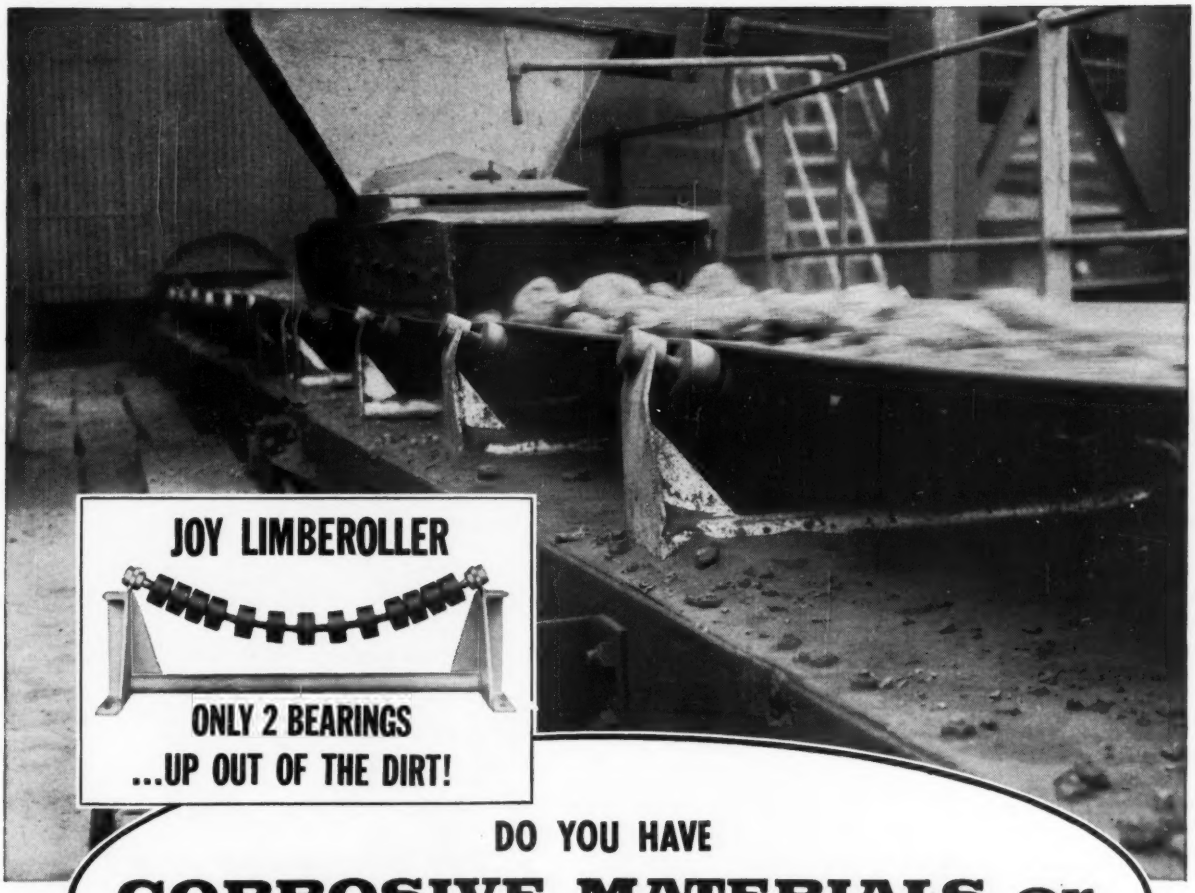

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The Joy Limberoller idler consists of neoprene discs molded on neoprene-covered flexible steel cable. It is suspended from two bearings, one on each end, *out of the dirt zone.* This distinctive design, field-proved by thousands of idlers already in service, averts fouled idler rolls—protects the belt from damage—reduces your maintenance to a fraction—*gives many times longer service life on dusty, gritty or corrosive jobs.*

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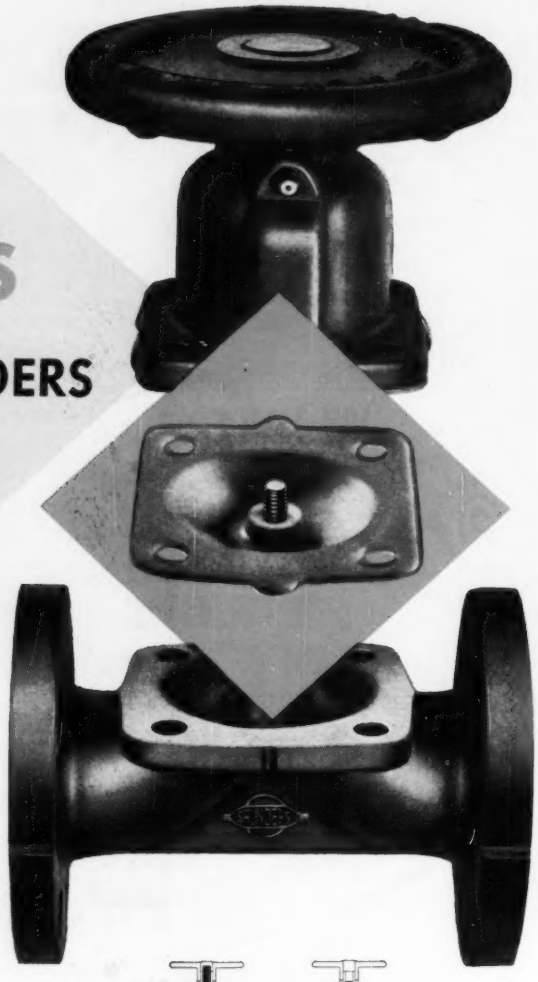

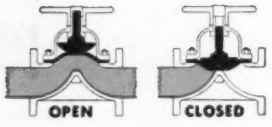

Having valve trouble? Are your chemical services so tough that valves disintegrate? Grinnell-Saunders Diaphragm Valves with TEFLON* diaphragms may solve your problems.

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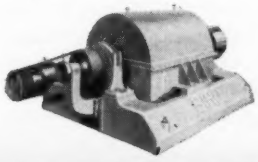

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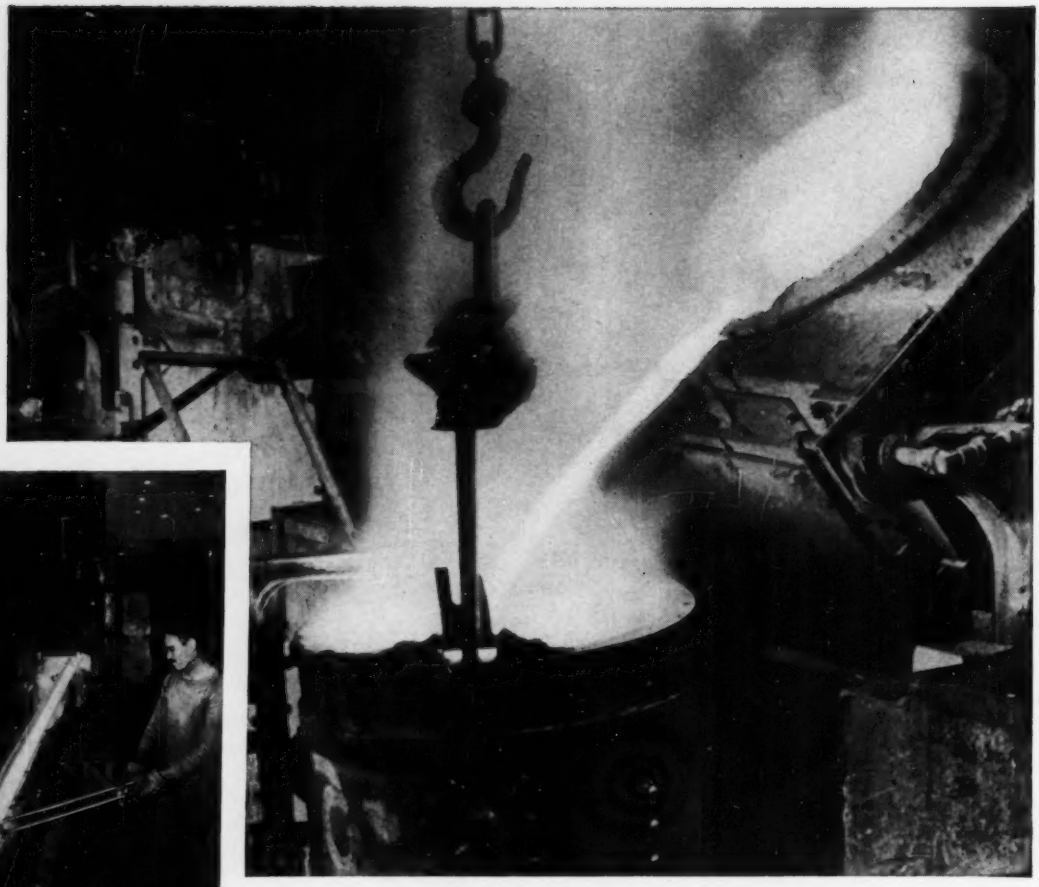

Comes in seamless tubing, pipe and extruded tubing — as well as other standard wrought mill forms.

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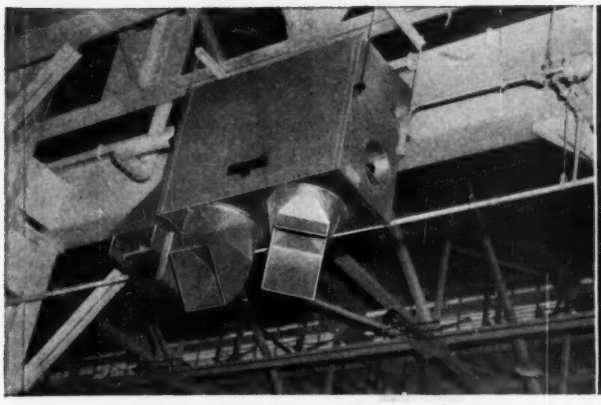
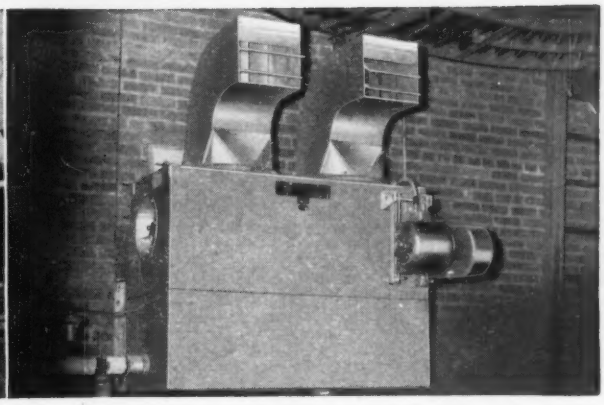


SUSPENDED "LOWBOY" HEATS, VENTILATES



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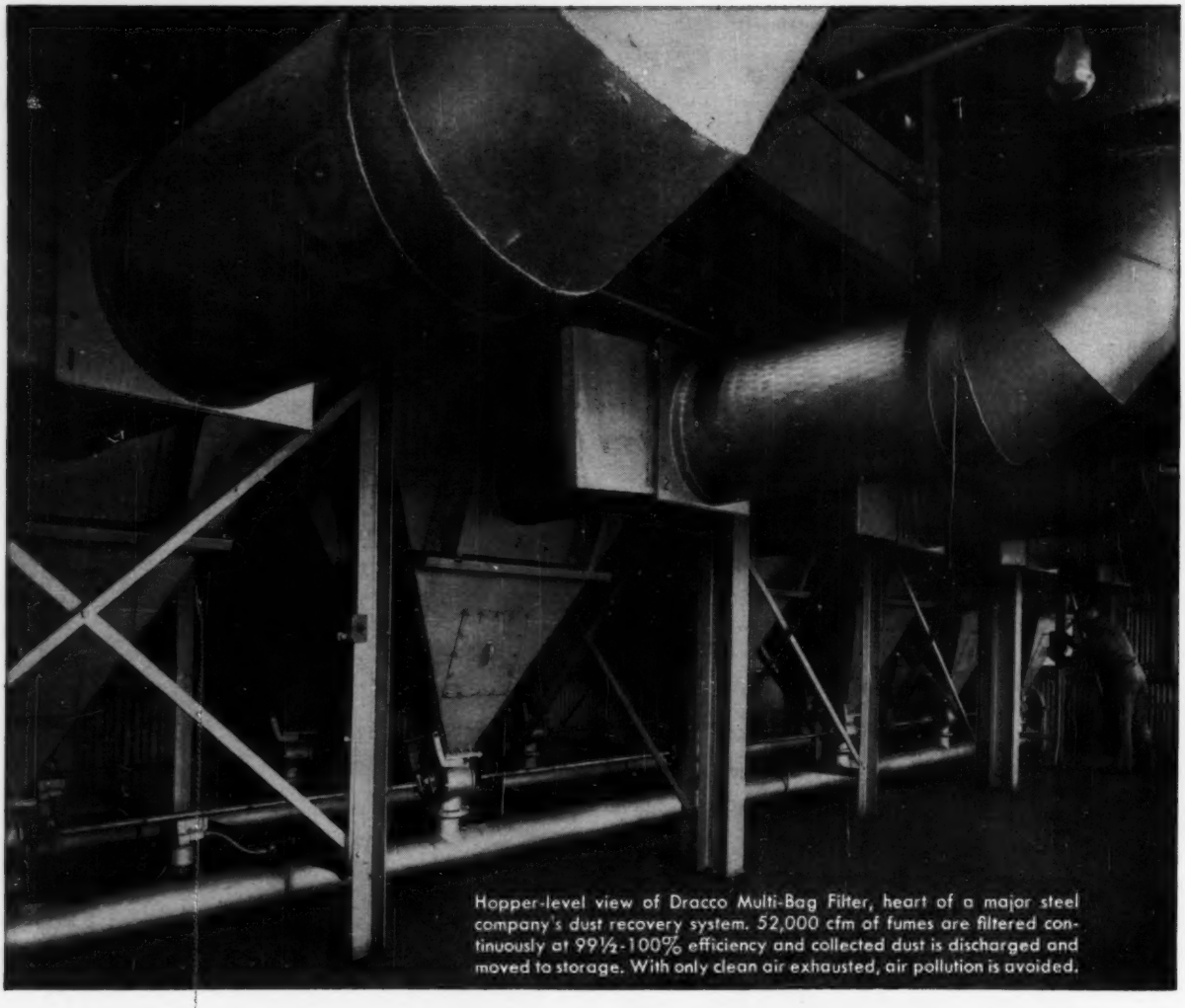

Hopper-level view of Dracco Multi-Bag Filter, heart of a major steel company's dust recovery system. 52,000 cfm of fumes are filtered continuously at 99½-100% efficiency and collected dust is discharged and moved to storage. With only clean air exhausted, air pollution is avoided.

air pollution halted...*at a profit!*

Air pollution is one of industry's biggest and most costly problems. But here's how one major steel company cleaned up a "hot" situation by controlling fumes from its secondary bronze smelter—*at a profit!*

Zinc oxide-laden clouds from the smelter were formerly being exhausted to the atmosphere, causing waste of valuable materials and complaints from a nearby housing development. A Dracco Dust Recovery System consisting of cooler, filter and dust conveyor has been installed to alleviate this problem.

The cooler receives fumes at 2000°F and discharges them at 235°F to the filter where zinc oxide is collected continuously. Only clean air is exhausted—all visible dust has been removed. The dust conveyor carries collected material to storage.

As a result of this corrective action, pollution of air from this source has been eliminated. The company is realizing new profits from the sale of materials formerly lost to the atmosphere.

Your plant may be causing unhealthful air pollution and wasting valuable materials unnecessarily. A Dracco dust control engineer will show you how you can convert these losses to profits, and improve relations with your community. Call him today!

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4040 East 116th Street · Cleveland 5, Ohio

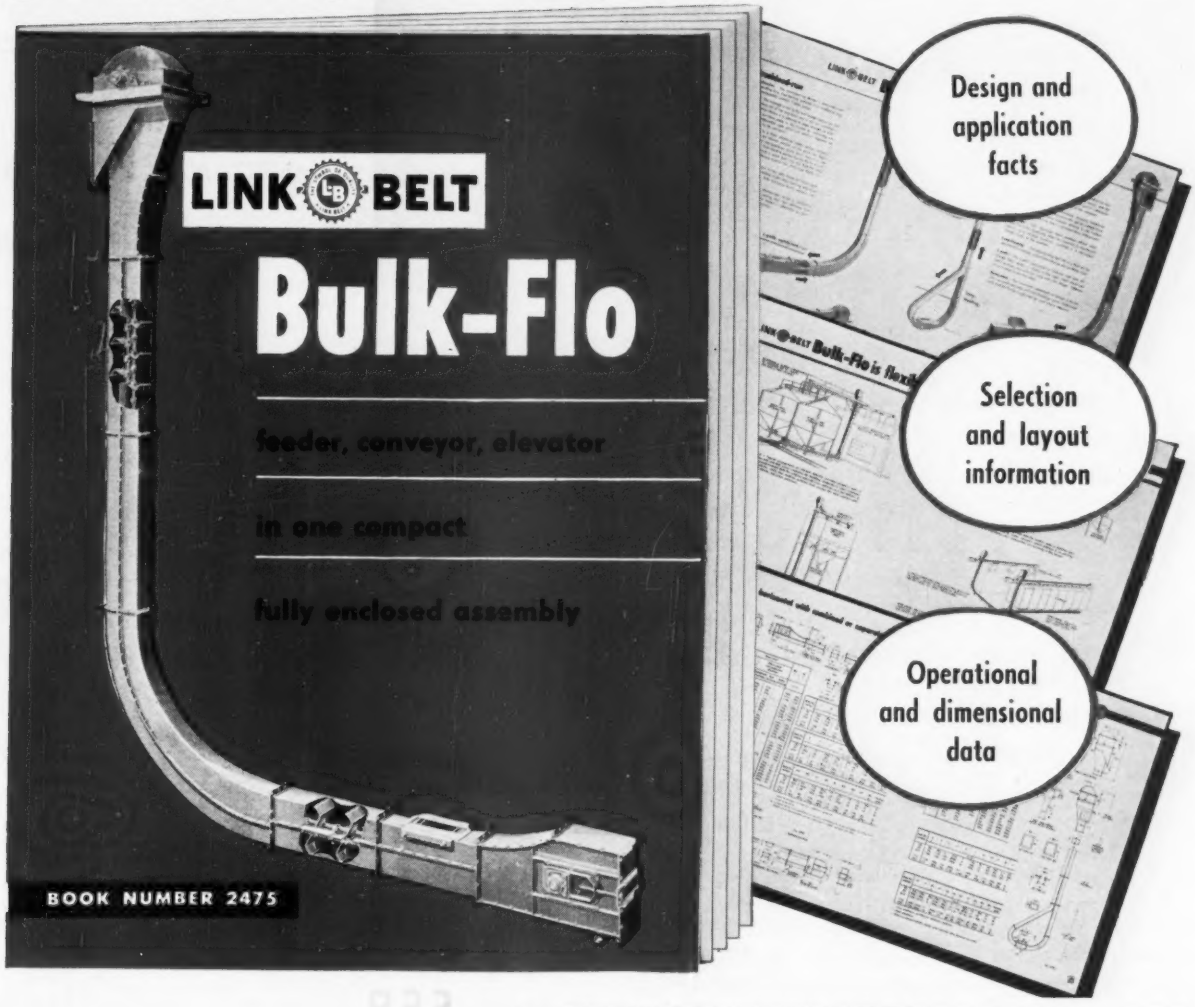
Want more information on Industrial Dust Recovery and Control? Write today for the 40-page Dracco Bulletin No. 800.

DRACCO *Performance Proved*
Airstream CONVEYORS · DUST CONTROL EQUIPMENT

GET THIS 28-page book on BULK-FLO . . . for feeding, conveying, elevating

Here's complete information on this versatile medium for moving granular, flaky and pulverized materials

The ability of Bulk-Flo to feed, convey and elevate in one totally-enclosed assembly offers many possibilities for improved, more compact materials handling. And Book 2475 gives all the information you need to determine its potential for your particular operations. Send for your copy of this comprehensive book.



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LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13.823

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Please send me a copy of your Book 2475, on Self-feeding Bulk-Flo Feeder-Conveyor-Elevator.

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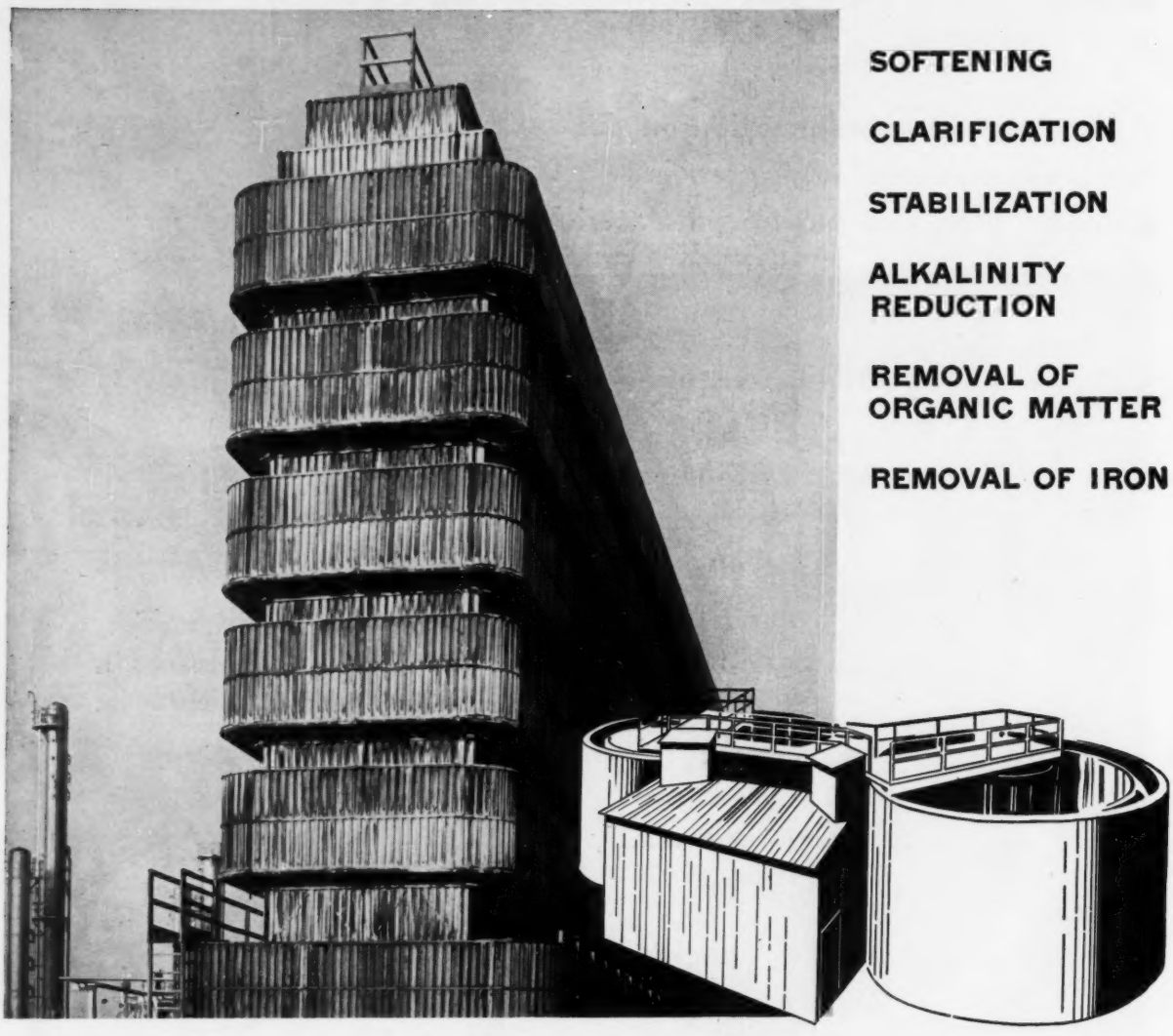
COOLING WATER PROBLEMS?

Let INFILCO engineers help you on...



SOFTENING

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REMOVAL OF ORGANIC MATTER

REMOVAL OF IRON

In heat exchange operations, where cooling water is involved, nothing is more important to effective, economical operation than clean, non-scaling, non-corrosive water. Whether your needs are small or large, the experience of INFILCO engineers and properly selected INFILCO equipment can solve your problem.

For partial softening and alkalinity reduction, removal of turbidity, suspended and organic matter, and iron, ACCELATOR® treating plants are widely used. For softening, zeolite softeners may be used alone or in conjunction with "ACCELATOR" treating plants. Side stream continuous clarification can be handled by one of several types of filters. For pH adjustment, chemical feeding equipment is available.

Such equipment is giving superior service throughout industry—in gas and gasoline plants, refineries, public utilities and municipalities. It will pay you to investigate. Write for complete details.

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The one company offering equipment for *all* types of water and waste treatment—coagulation, precipitation, sedimentation, filtration, flotation, aeration, ion exchange and biological processes.

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A Challenge!

. . . to write for the two No. 1 publications in the Chemical Process Industries

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Our magazines need several junior editors interested in personal growth and job satisfaction. Here are the basic qualifications:

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Both magazines have headquarters in New York City, with McGraw-Hill, world's largest publisher of business papers and books. If you think you can meet the challenge of one of these editorial opportunities, send us details on your personal background, experience, approximate salary requirements, along with any evidence of your writing ability. All replies will be treated confidentially.

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New YOUNG Stainless Steel Heat Exchangers offer greater initial and operating economies for heating or cooling liquids and gases used in the processing industries.

The superior design of the new YOUNG units provides more cooling surface per unit volume, and units can withstand radical temperature changes without danger of expansion strains. New tube bonding process eliminates leaks due to vibration, and unit is readily accessible for cleaning. Available in single, two-pass and four-pass design.

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OUTSTANDING NEW FEATURES

- Smooth Flow Bonnet distributes fluid with minimum turbulence.
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- Inside of Tubes accessible for cleaning.
- Units selected to include factors for fouling and safety.
- Heat expansion strains eliminated.
- New tube bonding process eliminates leaks.
- Immediate delivery of Cataloged sizes.

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Creative HEAT TRANSFER ENGINEERS FOR INDUSTRY

Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.

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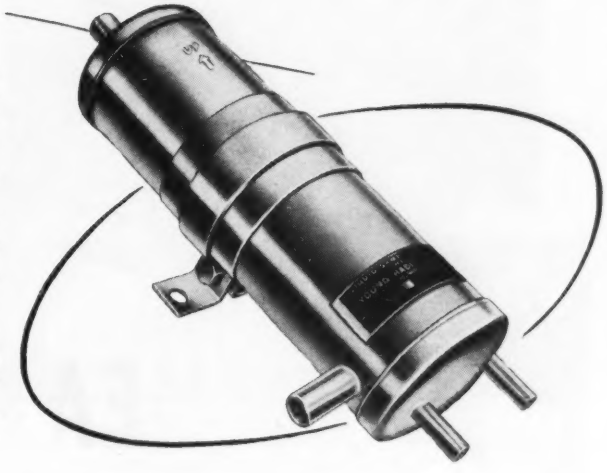
CHEMICAL PROCESSING
in heat transfer... YOUNG

SAMPLE FLUID COOLER

FOR SAMPLING
HIGH TEMPERATURE PROCESS FLUIDS

Reduces sample process fluid temperatures from 60° F. to 100° F. at pressures up to 1500 psi. Designed for control testing purposes for pilot plants, boiler water, chemical, and other high temperature and pressure process fluids. Units are scientifically and practically constructed to eliminate crevice corrosion and metal failure from continuous use. Inlet and outlets are ample size for minimum resistance to fluid flow.

YOUNG Sample Fluid Coolers are only 13 inches in length and provided with a convenient mounting bracket. For complete information, write Young Radiator Company, Racine 15, Wisconsin.



7 Outstanding Features

- Sturdy welded construction.
- Compact, space-saving design.
- Ample-sized inlet and outlets for minimum resistance to fluid flow.
- High corrosion-resistant tubes, shell, end caps and pipe connections.
- Cadmium plated steel bracket nuts and ring assembly.
- Permanent, leak proof brazed alloy joints.
- Convenient mounting bracket.

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Young Radiator Company
Racine 15, Wisconsin

Please send me catalogs on YOUNG Stainless Steel Heat Exchangers_____, YOUNG Sample Fluid Cooler_____.

Young Quality ®

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Company_____

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TRANSFORMERS
... the choice of leaders in industry

for shorter runs of copper... reduced line losses... lower installation expenses...

get the right voltage close to the load

with a

Wagner Dry-Type Transformer

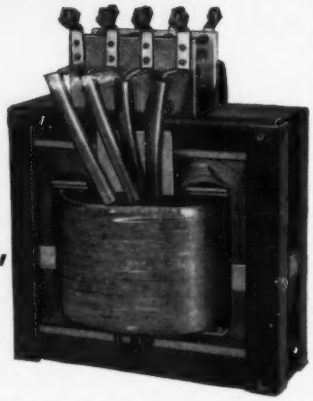
Wagner Dry-Type Transformers give dependable power distribution right at the load... close to your portable tools, machines or lighting system. This means a big savings to you in terms of shorter runs of copper, reduced line losses and lower installation expenses. Not only that, Wagner Dry-Type Transformers are compact, light in weight and safe to use—even in the presence of fire hazards.

The new 150° rise, totally-enclosed dry-type transformer with silicone insulation, is designed especially for use where ventilated transformers are impractical. When you install these transformers, fireproof vaults and other protective enclosures are unnecessary. Core and coil is protected from lint, moisture, dust and other contaminating materials by totally-enclosed sheet steel cases... and this kind of protection reduces maintenance to almost nothing. They can be installed outdoors, because their construction is completely weatherproof.

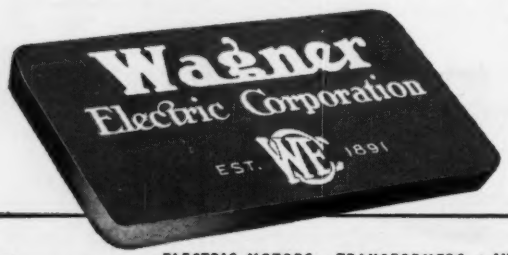
The 150° rise transformer is standard in ratings 3 through 10 kva and is also available through 50 kva. The 55° rise model is standard in 1, 1½ and 2 kva and the 80° rise transformer is standard in ratings 15 through 100 kva.

Wagner®
Form W

Core and Coil permits compact, lightweight transformers...



The heart of each Wagner Dry-Type Transformer is the famous Wagner Form W Core and Coil assembly. Core is of cold-rolled oriented grain transformer steel. The Form W design permits less weight per kva and small size cases for space saving installation.



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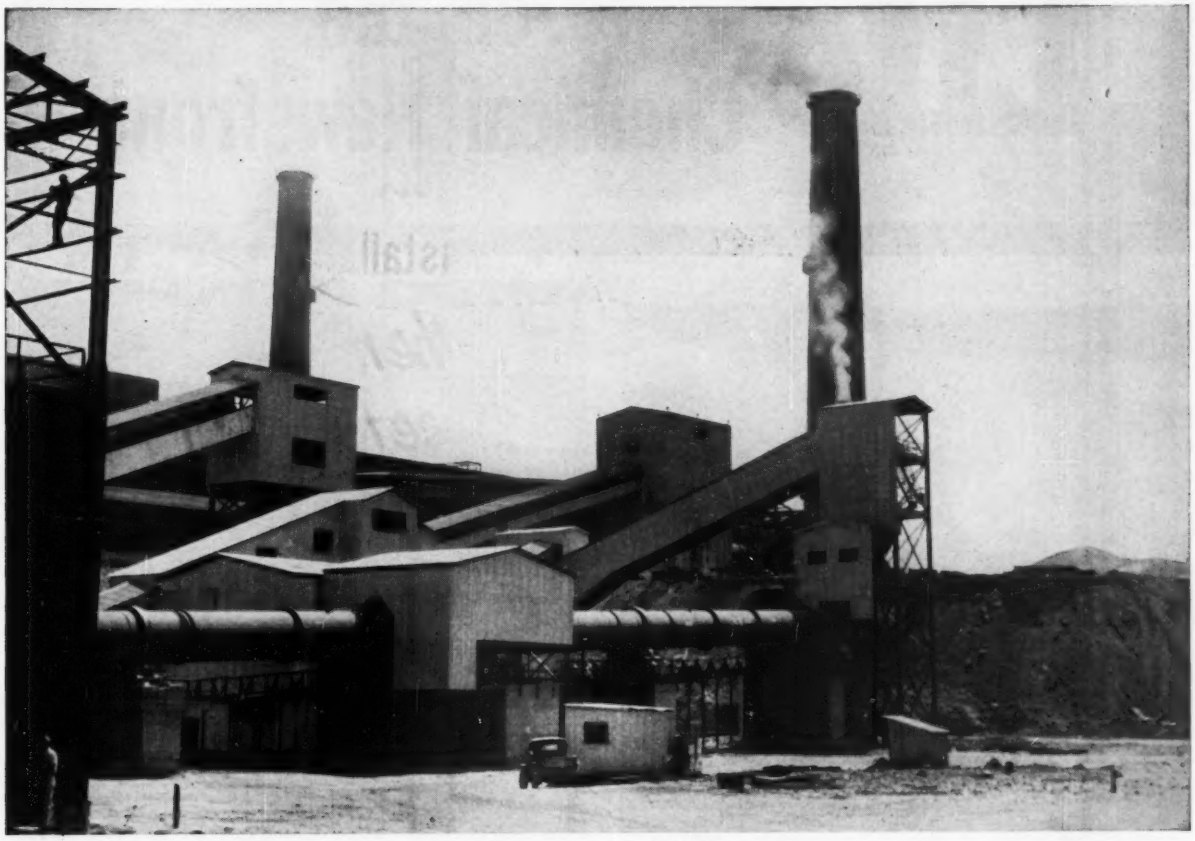
T55-41

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS-AIR AND HYDRAULIC

6 miles of "know-how"

offer a short-cut to profitable thermo-processing



OVER 150 TRAYLOR KILNS are your best assurance of an efficient installation

Traylor has built over 150 Rotary Kilns since 1941 . . . an average of almost one a month for 14 years. Their combined length is over 33,000 feet. This adds up to more than 6 miles of kiln building "know-how" for Traylor.

Kilns have been "Traylor-made" for processing some 21 different products. The answer to many new thermo-processing problems has been found in Traylor's accumulation of kiln-building experience. If you are responsible for efficient thermo-processing in your plant, take the short cut to a profitable installation. Avoid the long costly way of trial and error. Have a kiln "Traylor-made" for the job. Write for bulletin 1115 today.

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781 Mill St., Allentown, Pa.
Canadian Mfrs.: Canadian Vickers, Ltd., Montreal, P. Q.

A Traylor leads to greater profits

SEND FOR BULLETINS
. . . just mention the Traylor Equipment that interests you.

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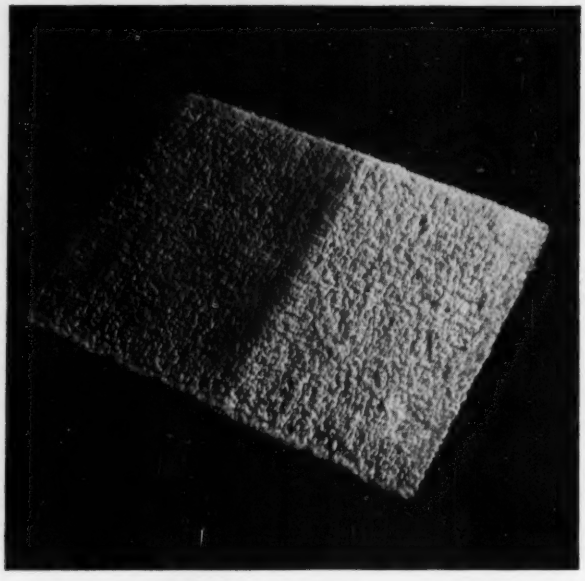
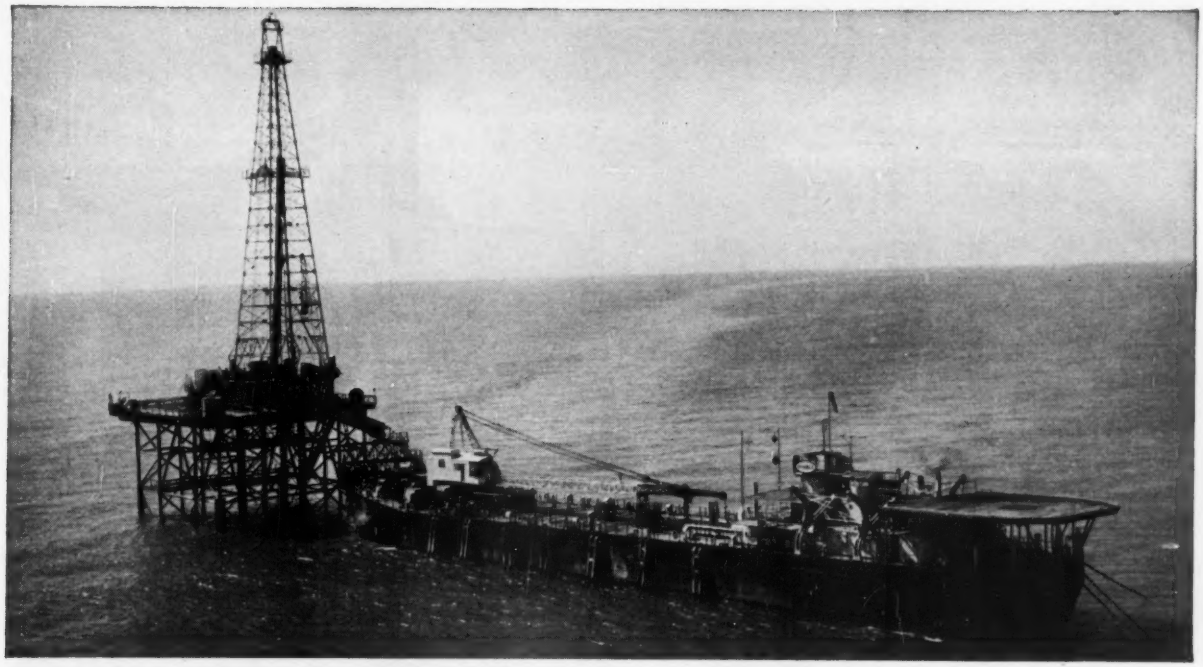
Life ...on the Chemical Newsfront

BLUETONGUE, A NEW DISEASE IN SHEEP first recognized in the U.S. a few years ago, now is spreading widely. Bluetongue may kill one out of five sheep infected, and severely set back the others. This virus disease has not been treated successfully but may be prevented with LEDERLE BLUETONGUE VACCINE developed by Cyanamid's Lederle Laboratories Division. Vaccination should be completed a full month before Bluetongue season arrives. Your veterinarian can give firsthand information. Our literature on Bluetongue disease and vaccine is available. **(Lederle Laboratories Division)**



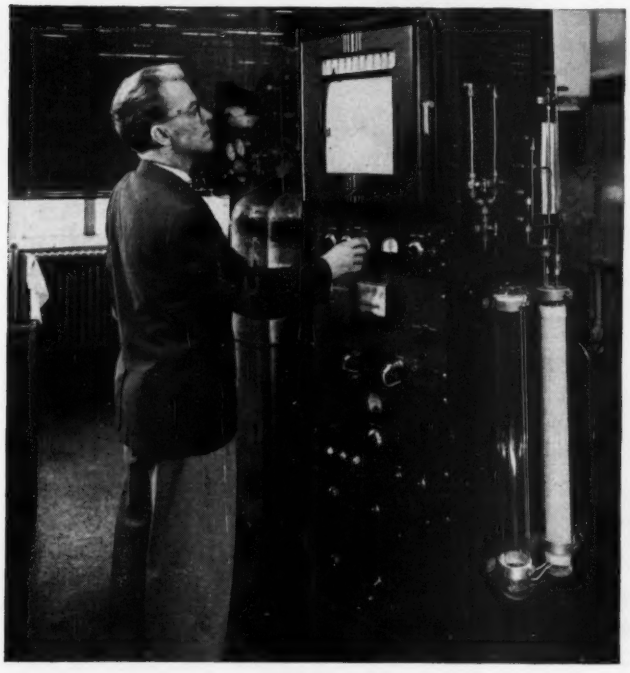
RUGS COLLECT LESS DIRT, are cleaned more easily when treated with CYANA® Soil Retardant. Illustration shows striking contrast between treated and untreated sections of same rug exposed to identical soiling conditions. CYANA Soil Retardant acts by filling the roughnesses on the fibers with an almost invisible protective surface. This prevents soil from clinging and makes it easier to remove dirt. This new improved compound should be particularly valuable for treatment of non-wool rugs, which are increasing in popularity but tend to soil more readily than wool. **(Textile Resins Department)**

PUT PLANT REFUSE TO WORK. Corn stalks and roots were decomposed almost completely from Fall to Spring to form soil humus when plowed under with AERO® Cyanamid Granular (left photo) but remained firm and woody without this nitrogen- and lime-containing chemical (right photo). Illustrations also show improved condition of the soil due to humus formation with AERO Cyanamid. The high nitrogen content of AERO Cyanamid not only feeds the bacteria, which hastens decomposition, but also assures ample supply of this important plant nutrient for growing crops. AERO Cyanamid's lime content helps prevent soil acidity. For years AERO Cyanamid has improved soil and increased crop yields for farmers, and now is available as LAWN AND GARDEN Cyanamid to speed production of humus for home gardeners. **(Agricultural Chemicals Division)**



NEW ORGANIC WATER-LOSS CONTROL REAGENT, known as CYPAN® Drilling Mud Conditioner, is outstanding under high-temperature drilling conditions and where contamination is encountered (as with salt in off-shore drilling). Laboratory and field tests have demonstrated its effectiveness at temperatures as high as 350° F even in the presence of considerable amounts of contaminants. CYPAN Drilling Mud Conditioner is a high molecular weight, water-soluble acrylic polymer which does not require preservative treatment to prevent fermentation. **(Industrial Chemicals Division)**

®Trade-mark



NEW VAPOR PHASE CHROMATOGRAPHY apparatus, developed in Cyanamid's Stamford Laboratories, automatically separates and identifies volatile organic liquids. Mixed vapors are separated in a partition column, and analysis is read directly on chart. Apparatus may be employed on stream or in research projects. Used at Stamford in research on new catalysts for petroleum refining, it permits rapid evaluation of catalyst efficiency. Cyanamid's extensive series of AEROCAT® Catalysts has reduced cost and increased efficiency in fluid catalytic cracking operations through development of catalysts with optimum particle shape, high pore volume, and extreme stability. **(Industrial Chemicals Div.)**

NEW WATER-SOLUBLE POLYMER, which forms water-insoluble films and coatings when air-dried or heat-cured, offers intriguing possibilities to paper, textile, adhesive and other manufacturers. The new polymer is methylolated polyacrylamide and may be made by treating aqueous solutions of polyacrylamide with formaldehyde using basic catalysts. Variation in properties may be obtained by changing processing conditions and by use of polyacrylamide of different molecular weights. Dried films of methylolated polyacrylamide are clear and hard, insoluble in boiling water, and may be softened somewhat by water immersion. Dilute solutions of the new polymer are stable for at least six months at pH 6-7. Samples of polyacrylamide and directions for methylolation are available on request. **(New Product Development Department)**

C. E.

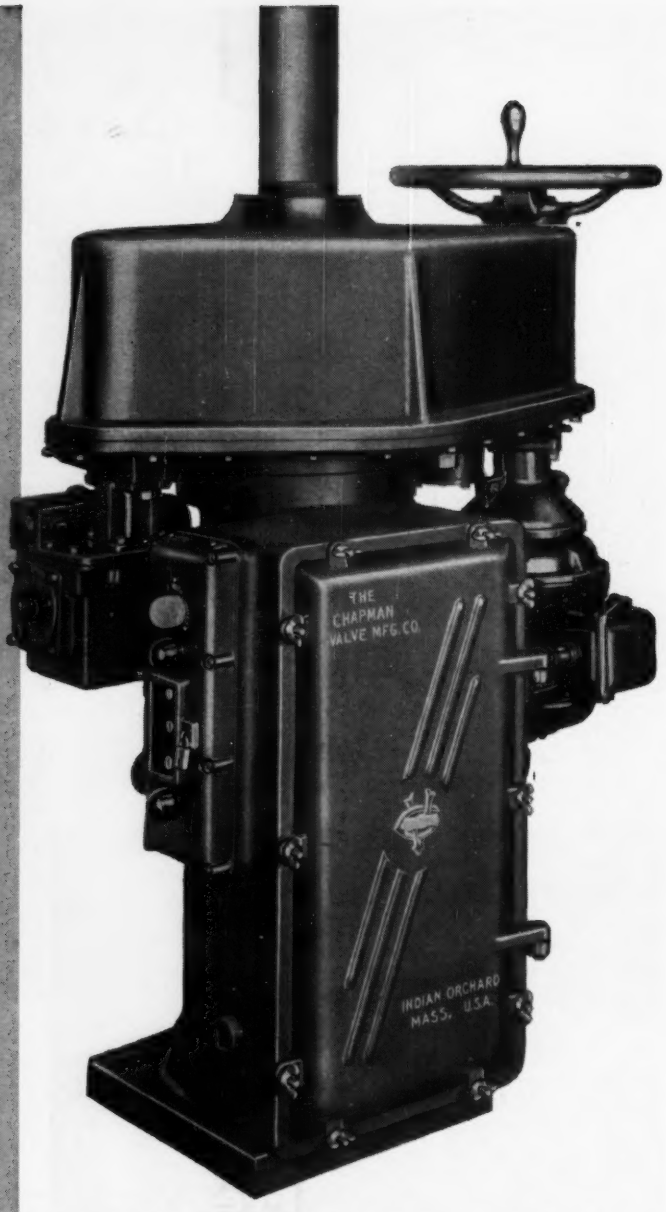
AMERICAN Cyanamid COMPANY

30 Rockefeller Plaza, New York 20, N. Y.

Additional information may be obtained regarding these products by writing on your business letterhead to the Division of American Cyanamid Company, 30 Rockefeller Plaza, New York 20, N. Y., indicated after each product.

Fewer Parts Mean Greater Dependability

Floorstand Motor Unit . . . control panel, motor, limit switch and push button station.



Simple, durable mechanism of Chapman's Motor Unit. Handwheel remains stationary during motor operation.

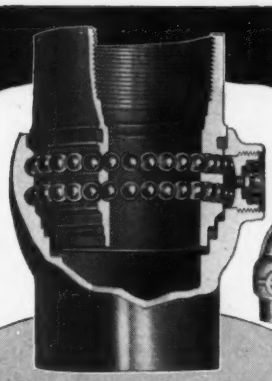
IN CHAPMAN MOTOR UNITS

Chapman's simple and rugged Motor Unit gives accurate, trouble-free control of large valves and sluice gates. It has approximately *half as many parts* as any other unit. Its simplified design, low speed motors and low-ratio, stubtooth gears combine to give positive operation without drift, in *any* position and under all conditions.

Installation is fast and simple. The floorstand unit comes completely wired, ready to connect to leads. Limit switch has micrometer adjustment for exact pre-setting for seating tightness. Motor Units operate smoothly under the most adverse conditions. All units are weather-proof and steam-tight. Write today for *new* Catalog 51.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

STEEL
BRONZE
MONEL
ALUMINUM



No. 80
No. 80F
No. 10
No. 10F
No. 70FX5
No. 70X5
No. 20
No. 20F
No. 70F
No. 30
No. 30F
No. 70
No. 30X4
No. 30FX4
No. 50FX1
No. 30X5
No. 30FX5
No. 60
No. 40
No. 60F
No. 40F
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No. 50FX5
No. 40X5
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OPW
swing joints

FULL UNRESTRICTED FLOW • EFFORTLESS MOVEMENT
GREATER LOAD CARRYING CAPACITY • "O" RING SEALED
CONTAMINATION FREE OPERATION • PERFECT ALIGNMENT

The wide range of sizes and styles of OPW BALL BEARING SWING JOINTS offers many and varied applications for safely handling liquids of diversified viscosity at required temperatures and working pressures.

Millions of gallons of all types of liquids are moved daily in flow lines where perfectly sealed, rotating OPW Swing Joints provide an almost limitless range of flexible operations.

Join other users of OPW Swing Joints. You can also realize economies in your liquid products handling.

Free Catalog F-8
provides engineering data, sizes, styles, recommendations and prices.

SWING EASY!

OPW CORPORATION FOR HANDLING HAZARDOUS LIQUIDS
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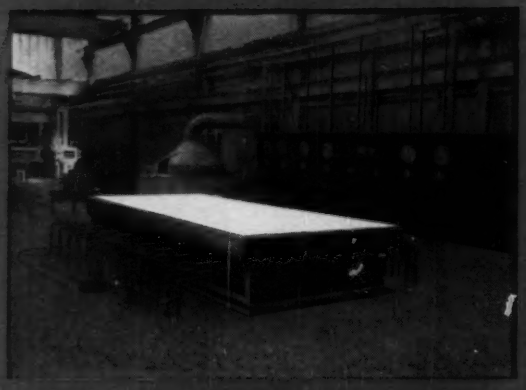
KELLEY

Pioneers in HOMOGENEOUS LEAD BONDING

First Again with a "NEW MECHANICAL"* Bonding Process

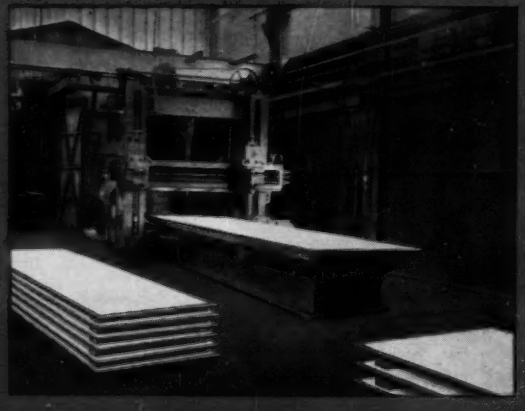
"Our newly developed "mechanical" process for applying **Homogeneous Lead Bondings** affords you a considerable saving in both delivery time and cost over the slower "hand-burning" method.

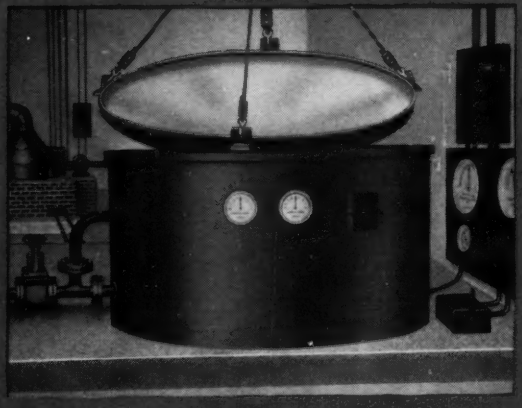
We suggest that you pay a visit to our plant and view this newly developed "Mechanical" cost-saving lead bonding process. Our Engineers are available for consultation without obligation. Your inquiries are solicited.



Homogeneous Lead Bondings are applied to any thickness of shell plates in the flat before shaping to your specifications. Plates as large as 10'-0" x 20'-0" are easily handled on our new unit, thus eliminating many unnecessary weld seams. Outlets and connections are Homogeneously Bonded regardless of size.

To insure uniform overall thickness of the Homogeneous Lead Bondings and eliminate the human errors occurring in other methods, lead is applied "oversize" to flat sheet plates and then planed to required thickness. In addition, this operation affords considerable savings in time over the general "Hand Scraping" method.





Dished Heads of all types and various irregular shaped pieces of equipment are Homogeneously Lead Bonded in our Special "MECHANICAL" Unit. Here again, considerable saving in time and cost is effected over the general method.

KELLEY Custom-Built for the Processing Industries

TANKS · LEAD COILS · LEAD & LEAD LINED VALVES
SHEET LEAD LININGS · CASTINGS & FITTINGS

STAINLESS STEEL
LEAD
WOOD
STEEL
Fabrication

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Pumping Progress Report

FOR HYDRAULIC ENGINEERS

An advertisement prepared by the Aldrich Pump Co. Member of Hydraulic Institute, U.S.A.

UREA PRODUCTION, like many other chemical processes, presents difficult pumping problems. Urea slurry is both corrosive and erosive. Either condition can cause serious operational headaches; together they spell trouble for both design and maintenance engineers.

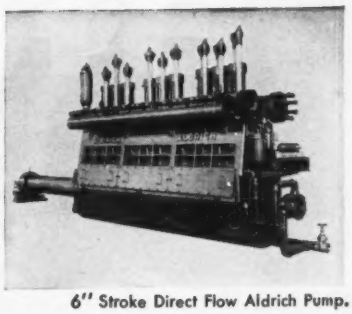
PUMPING UREA SLURRY was the problem given to the Aldrich Pump Company Engineers by one of the foremost producers of urea. Our solution was effective. We recommended...

A 6" STROKE DIRECT FLOW TRIPLEX with several material of construction modifications. Porcelain plungers were used instead of the usual hardened alloy steel. The entire fluid-end was made of Hastelloy B, but Direct Flow Fluid-End construction was maintained to give minimum cost of parts replacement in the event of unavoidable corrosion or erosion damage.

ALDRICH DIRECT FLOW DESIGN offers many advantages to reciprocating pump users. Two right angle turns are eliminated in the fluid-end block. The liquid being pumped travels in a straight line, on a horizontal plane, from the suction to the discharge manifold. Reduced space between valves results in higher volumetric efficiency and extra close valve clearance.

SECTIONALIZED FLUID-ENDS also afford greater economies of maintenance. Valves can be removed for inspection or replacement without special tools or equipment. Individual sections of the fluid-end can be replaced at a fraction of the cost of conventional type fluid-ends.

DATA SHEET 67A illustrates and describes the Aldrich 6" Stroke Direct Flow Pump Series. This Series includes Triplex, Quintuplex, Septuplex and Nonuplex Pumps, ranging in power from 300 to 900 hp. Aldrich Engineers are available to help you solve your tough pumping problems. Address your request to: The Aldrich Pump Company, 3 Gordon Street, Allentown, Pa.



6" Stroke Direct Flow Aldrich Pump.

...for your tough pumping problems specify ALDRICH

Long, trouble-free service life and low cost are assured features of this pump. It is characterized by the unique Aldrich Direct Flow design and rugged construction that have made Aldrich Pumps famous. Modifications can be made to adapt the unit to many types of service. Sectionalized fluid-ends afford fullest economy in maintenance and repair.

TYPICAL CHEMICAL APPLICATIONS FOR ALDRICH PUMPS:

caustic solutions	fatty acids
anhydrous ammonia	nitric acid
amine solution	cobalt solutions
viscous liquids	acetic acid
nickel catalyst	abrasive slurries

Send for specific data in new catalog. Or, if you have a special problem, ask one of our representatives to call.

THE ALDRICH PUMP COMPANY

Originators of the Direct Flow Pump

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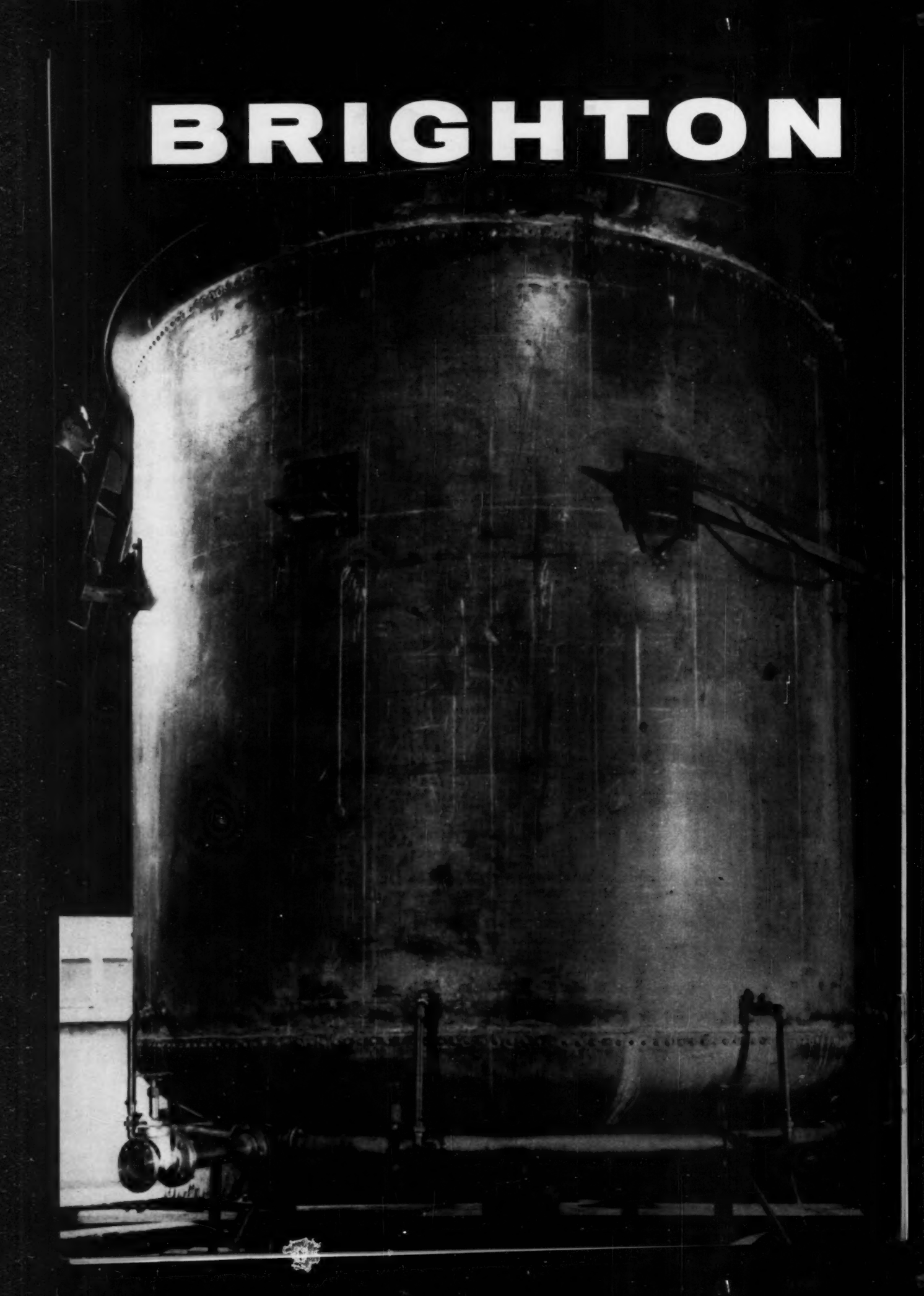
ALLENTOWN, PA.

Representatives in principal cities

BRIGHTON



BUILDS THE BIG ONES!

This Vessel is a heavy copper still kettle, riveted and silver brazed—used for chemical distillation. Building huge kettles like this is an important part of our business at Brighton.

We work metal—stainless steel, copper, bronze, aluminum, nickel, monel metal and other alloys. More important, our craftsmen make metal work for you! They build with precision to your specification, select highest quality tested metals, finish your job with a thoroughness that only true craftsmen can provide. Heart and pride are in their work.

We have facilities and skilled metalsmiths to build chemical process equipment of virtually any size—pilot model to full scale. Typical work—fractionating columns, heat exchangers, pressure vessels (jacketed or unjacketed), agitating equipment, tanks, coils, evaporators. We will be happy to submit a prompt estimate on your fabrication job. Write today for full information.

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BRIGHTON COPPER WORKS, INC.

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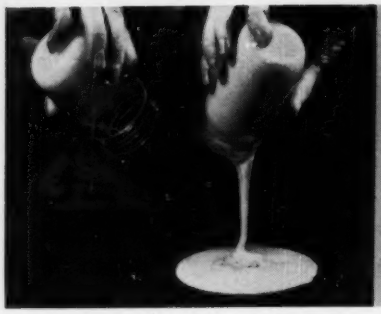
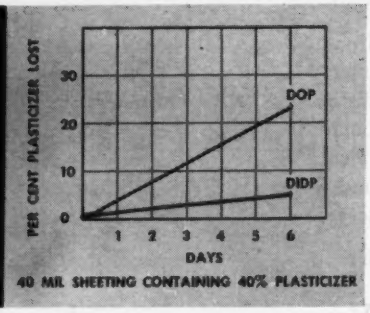
for your information...

brief summaries of helpful product news





SUPERIOR VISCOSITY STABILITY OF DIDP (right) vs. DOP after one-week storage at 50°C. DIDA and DIDP also give plastisols low *initial* viscosity. All decyl plasticizers are superior to comparable octyl esters in this characteristic.

LOW VOLATILITY OF DIDP—An important factor affecting the *permanence* of a plasticizer. Desirable properties are retained even after severe heat aging. All decyl plasticizers are superior to comparable octyl esters in this characteristic.

Boost profits by broadening production with Monsanto's decyl plasticizers

Increasing numbers of alert production men in the plastics industry are becoming aware of the fine job that decyl plasticizers can do in broadening the scope of production.

For example:

S-606 (mixed phthalate) . . . Santicizer* 606 offers optimum processing characteristics, alkali and grease resistance and flexibility at the lowest pound-volume cost. Specially suited for vinyl floor tile.

S-603 (butyl decyl phthalate)... Santicizer 603, a low pound-volume cost plasticizer. Offers good flexibility, good color, low specific gravity, fusion characteristics similar to DOP. Used in coatings, sheeting, extrusions and plastisols.

DIDA . . . Offers excellent low-temperature flex and lower volatility than DOA or DOP. High tensile strength, good heat and light stability, excellent moisture resistance. Used in garden hose, free film and sheeting, coated fabrics.

DIDP . . . Low volatility, excellent retention of properties after severe heat aging, good electrical properties, superior plastisol viscosity stability. Excellent resistance to extraction by soapy water. Used for thin films, upholstery materials, wire coatings, plastisols, floor tile.

S-602 (iso octyl iso decyl phthalate) . . . Santicizer 602 is resistant to soapy-water extraction and features good alkali resistance, lower volatility than DOP or DIDP (other properties comparable). Used for floor tile, plastisols, film, sheeting, coated fabrics.

Improved 100-lb. packing of vanillin and ethavan

100-lb. shipments of Monsanto Vanillin and Ethavan* are now available in a new, improved Leverpak drum with polyethylene liner.

These easy-to-handle drums offer greater ease of opening and closing; they also have a higher resale value than ordinary containers. Contents are protected from contamination and moisture pick-up.

Coatings manufacturers have found that Monsanto Ethavan and Vanillin, supplied in pure, fine crystal form, can be added to compounds without lowering their viscosity. Temperature extremes required for hot or cold processing won't affect the flavor potency of these two fine products.

Reinforced plastics fill industry need for rugged glazing

The recent growth of reinforced plastics in the consumer field has tended to obscure an equally important advance in the field of industrial applications.

Management of large industrial plants is turning more and more to reinforced plastic panels for sidelights and skylights.

These panels are extremely strong and virtually shatterproof. They are lightweight, easy to assemble, translucent and require a minimum of maintenance. In addition, they are highly resistant to the effects of sun and weather.

Monsanto plays an important role in furnishing the raw materials for the resins which go into these reinforced plastics: maleic and phthalic anhydrides; styrene monomer; fumaric and adipic acids.

Pydraul F-9 wins UL listing; 2 new Pydraul grades developed

On May 31, 1955, Pydraul* F-9 became the world's first fire-resistant hydraulic fluid listed by Underwriters' Laboratories. From the Laboratories' Service Card: "The fire hazard of Pydraul is rated 2 to 3 in accordance with Underwriters' Laboratories, Inc.'s Standard of Classification in which ether rates 100, gasoline rates 90-100, alcohol (ethyl) rates 30-40 and paraffin oil rates 10-20."

For lubricity, stability and service life, Pydraul F-9 equals the performance of premium petroleum fluids. The Timken lubricant test shows Pydraul has a film strength of 17,500 psi, while ordinary petroleum-based fluids rate only 5000. The Almen wear tests using Pydraul showed only 2 mg. of metal lost in a 20-minute run. With petroleum oil, metal seized in one minute under the same load. Pydraul F-9 is also re-usable, noncorrosive, stable and economical.

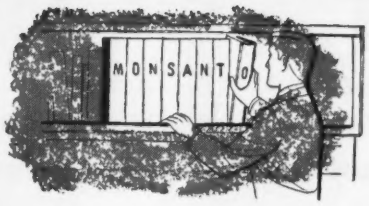
Two new grades of Pydraul are now available:

PYDRAUL 600 is a fire-resistant hydraulic fluid which delivers maximum performance where a high-viscosity fluid is required.

Designed originally for use in die-casting machines and presses, Pydraul 600 has also gained wide acceptance in other applications such as a lubricant for air compressors.

PYDRAUL 150 is designed for use in equipment where a low-viscosity fluid or low-temperature operation is required. Pydraul 150 is commonly used in regulating equipment throughout the steel industry, particularly in out-of-doors installations.

For more information on Pydraul hydraulic fluids, check the coupon.



Versatile germicide's uses, applications described in detail

All those interested in germicidal formulations will find Monsanto's newly revised booklet on Santophen* 1 a valuable production guide.

In addition to listing typical disinfectant formulations, the booklet discusses disinfectant-cleaner combinations and the role of Santophen 1 as a sanitizer in laundering and as an agent in industrial preservative applications.

Check the coupon for your copy.

Versatile industrial preservative subject of expanded bulletin

In the revised and expanded technical bulletin on Santobrite,* Monsanto's sodium pentachlorophenate, technical, production men will find up-to-date information on solution preparation, shipping, and safe handling.

Santobrite has proved effective and economical in the prevention of microbiological attack during the processing of such industrial products as textiles, starches, adhesives, leathers, oils and paints.

For your copy of the 12-page bulletin (No. O-23) check the coupon below.

New Monsanto aspirin plant on stream

Out of the industry's most modern plant is coming Monsanto aspirin, characterized by maximum purity and stability.

These important characteristics should be of interest to pharmaceuticals manufacturers in view of proposed USP maximum standard of .15% free salicylic acid in aspirin tablets.

The high degree of purity, essential for achieving maximum stability, is assured by Monsanto's manufacturing process in which the aspirin remains in a closed system of reactors, pipe lines, ducts and hoppers until it is ready for packaging.

In addition to uniform purity and stability, Monsanto's new aspirin retains all its long-standing advantages which make it easy and economical to handle and tablet.

*Reg. U. S. Pat. Off.

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Please send me the items checked below:

- ☐ Santicizer 602, Tech. Data Sheet
- ☐ Santicizer 603, Tech. Data Sheet
- ☐ Santicizer 606, Tech. Data Sheet
- ☐ DIDA, Tech. Bul. No. O-113
- ☐ DIDP, Tech. Bul. No. O-108
- ☐ Pydraul F-9, booklet
- ☐ Santophen 1, booklet
- ☐ Santobrite, Tech. Bul. No. O-23

In addition, I would like information about:.....

.....

Name..... Title.....

Company.....

Street.....

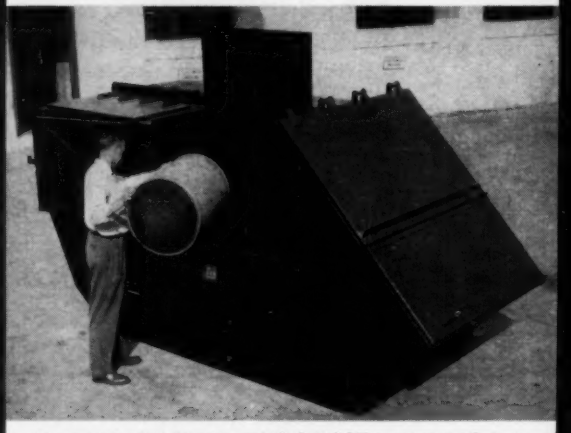
City..... Zone..... State.....

COLLECT IT

AS IT ACCUMULATES — SOLIDS, POWDERS, SLUDGE, LIQUIDS
RAW MATERIALS, FINISHED PRODUCTS, WASTE MATERIALS

Heavy waste is dumped into an open container at a foundry in New York. The first step in the LOAD LUGGER SYSTEM of materials handling is to place a number of containers at strategic points to collect material as it accumulates, reducing handling at the point of origin.

Light material accumulates in an open container with high sides at a shipping carton plant in Louisiana. Rugged LOAD LUGGER containers are built of welded steel, have deep leak-proof bottoms, hold from 1½ to 14 cubic yards and more, and handle all types of material.



It is easy to load this 14-cubic-yard LOAD LUGGER container of a St. Louis contract hauler. It fills to the top without raking and is wind-proof and rat-proof. A model with rubber seals and latches is also theft-proof, fly-proof, dust-proof, and almost odor-proof.

PICK IT UP

ALREADY LOADED — NO LOST TIME AND NO LOADING CREWS
LET ONE TRUCK AND DRIVER DO IT ALL — REPLACING MANY

A full container is picked up at a refinery in Indiana. The second step in the LOAD LUGGER SYSTEM is for one driver and his truck equipped with a hoist-body to pick up full containers on a regular schedule. This procedure does away with lost time and loading crews and eliminates the need for several conventional trucks and their drivers.

A bearing manufacturer in Ohio picks up a full container of dolomite. LOAD LUGGER hoist-bodies (flat-bed truck bodies with a pair of hydraulic-powered hoisting arms) handle pay loads of up to 18,000 pounds and more. They are easily mounted on any truck chassis of suitable capacity, and all controls are installed in the cab.

An open container used for accumulating industrial wastes is picked up by a Chicago contract hauler. For greater safety, LOAD LUGGER hoist-bodies lift containers with four-point suspension and have double-acting hydraulic cylinders for positive control at all times.

LOAD LUGGER®

ENGINEERING B-W PRODUCTION

• FLAT-BED TRUCK BODIES WITH HYDRAULIC HOISTING ARMS
• LEAK-PROOF TILT-DUMP CONTAINERS FOR BULK MATERIALS

HAUL IT

IN MANY TYPES OF CONTAINERS — OR ON THE TRUCK BED IN PLANT AND OVER THE ROAD — ON YOUR TRUCK CHASSIS

A city truck in Ohio hauls a full container of repair materials. Government approval is evidenced by the many such municipal, state, and federal installations. Hauling full containers is the third step in the LOAD LUGGER SYSTEM, and over-the-road hauls are as feasible as in-plant because of the use of standard truck chassis.

A full container of residue materials is hauled at a corn products processing plant in Illinois. LOAD LUGGER hoist-bodies carry containers well forward for correct load distribution and cradle them between steel sidewalls for greater travel safety.

LOAD LUGGER hoist-bodies also carry materials or equipment directly on their flat beds, loading and unloading heavy objects with their hoisting arms.

This special hoist-body of a Michigan telephone company transports heavy cable reels. Such new uses for LOAD LUGGER equipment are constantly being developed.

ENGINEERED, MANUFACTURED, AND MARKETED BY BROOKS EQUIPMENT & MFG. CO., SUBSIDIARY OF

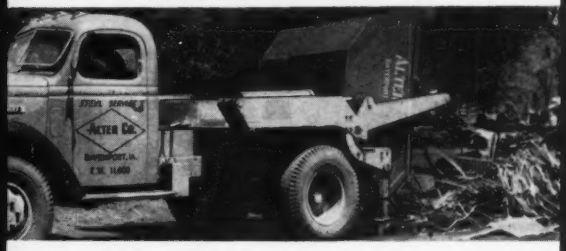
BORG-WARNER

CORPORATION — DISTRIBUTED INTERNATIONALLY

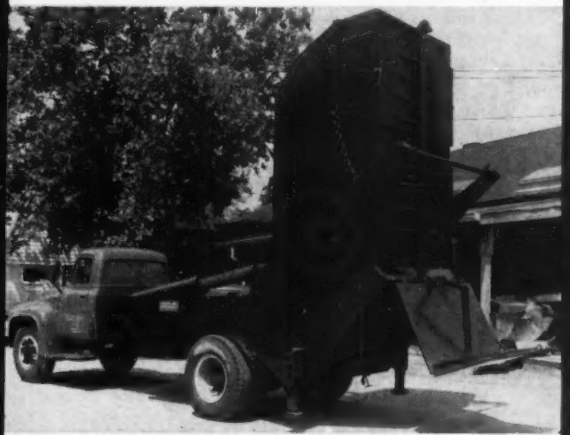
DUMP IT

BY TILTING CONTAINER VERTICALLY OVER REAR APRON, OR DELIVER IT BY EXCHANGING FULL CONTAINER FOR AN EMPTY

Spent solvents are dumped into incinerator tank at a drugs and medicines manufacturing plant in Michigan. Delivering full containers or dumping their loads is the fourth step in the LOAD LUGGER SYSTEM. Returning empty containers then completes the cycle.



Metal scrap is dumped and spread in the yards of a scrap metals service company in Iowa. LOAD LUGGER hoist-bodies handle more pay load on a given truck chassis, because they are lighter than comparable equipment. And their patented simplicity, clean design, and sturdy construction make them cost less to buy and maintain.



Equipment of a Miami contract hauler in the dumping position. The LOAD LUGGER hoist-body has outrigger jacks to protect rear springs and axles from injury while picking up and putting down heavily loaded containers, but it neither needs nor uses these jacks while tilting container over rear apron to dump or spread the load.

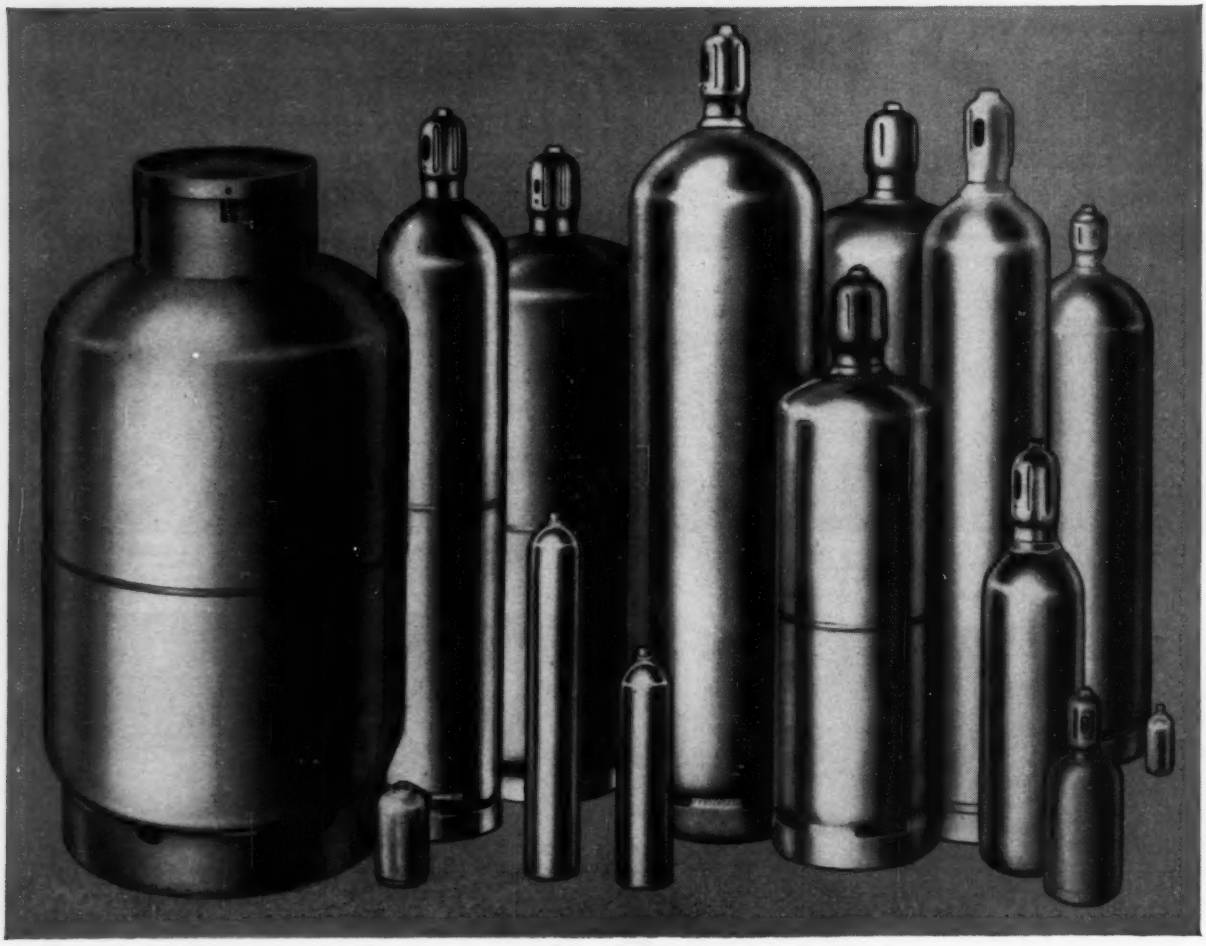
For more information mail this coupon to: BROOKS EQUIPMENT & MFG. CO. 2060 Davenport Rd., Knoxville, Tenn.

Name and position

Name of company

Street address

City, zone, state



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Hackney compressed gas cylinders are designed with low tare weight for easy handling and freight-saving shipping—either empty or filled. Yet adequate strength is always assured by the use of selected, high-grade steel. The Hackney manufacturing process draws the side walls to uniform thickness that eliminates unnecessary weight.

Hackney cylinders are uniform in size and weight—uniformly easy to handle—uniformly durable for long service with the busy chemical shipper. Made in many sizes—for high-pressure or low-pressure shipment of all types of gases. Write today for full details.

Hackney cylinders are regularly furnished for shipping compressed gases such as:

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Anhydrous Ammonia	Helium
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Refrigerant Gases	Sulphur Dioxide
Butane and Propane	Sulphur Hexafluoride
Carbon Dioxide	Anhydrous Hydrogen Chloride
Oxygen	Boron Trifluoride
Methyl Bromide	*—and many, many others*
Nitrogen	

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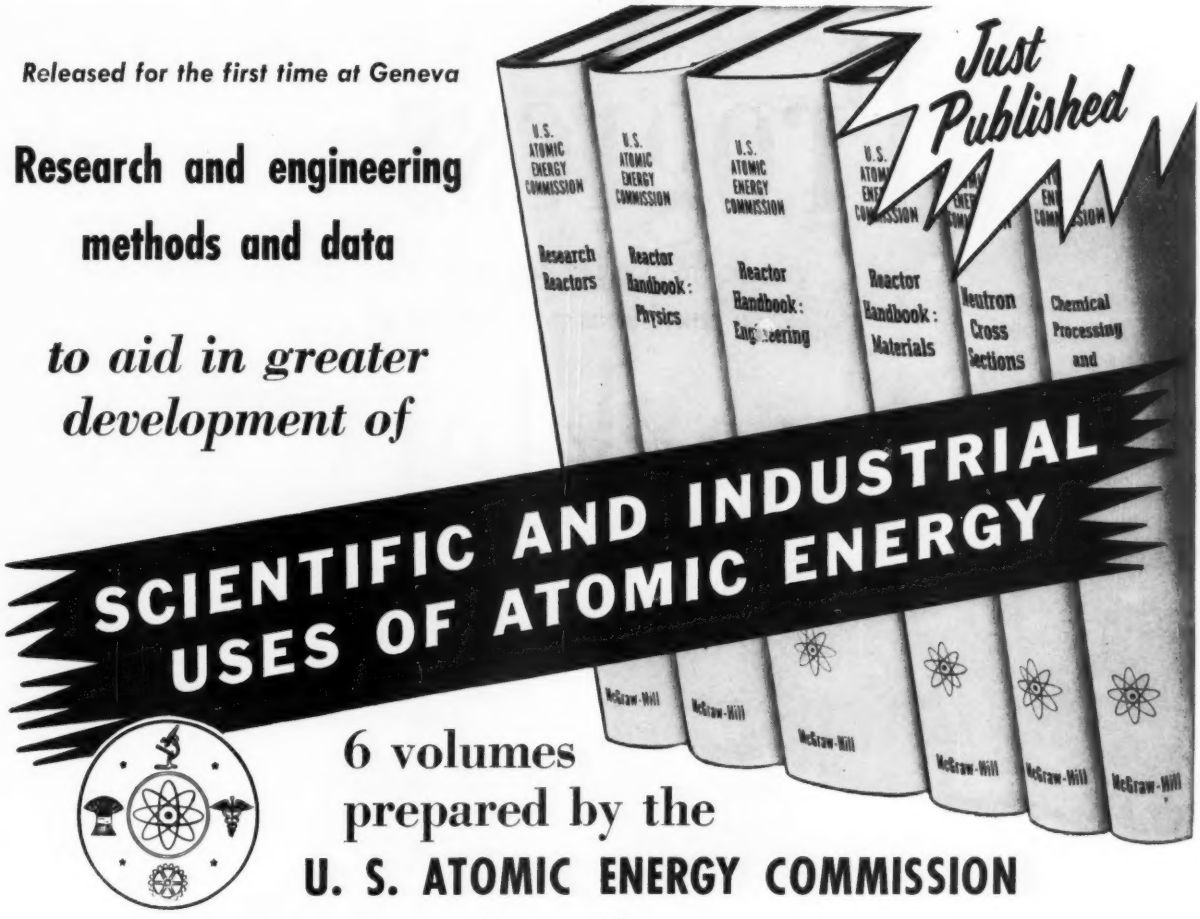

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Prepared as a contribution to the nations represented at the Geneva Conference, August 1955, to aid world-wide advance in the beneficial use of atomic energy, the information now is available to scientists and engineers of the United States, in six technical-engineering volumes published by McGraw-Hill.

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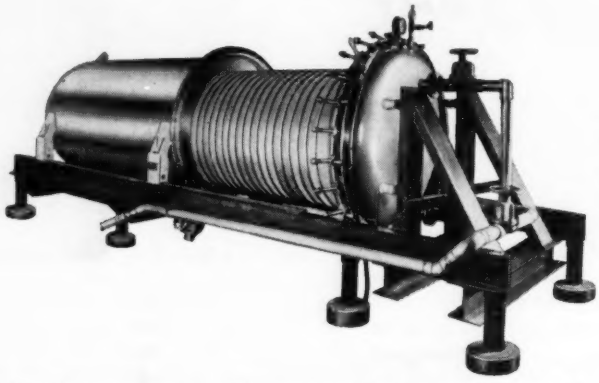

Built to A.S.M.E approved specifications when required.

The retractable tank Model MCR filter is an example of Sparkler engineering progress. In designing the MCR, the first consideration was to produce a heavy duty filter capable of handling a large production volume; with fast, uniform quality filtration, and with low labor cost.

Cheapness in mechanical construction to produce a competitive priced filter was not attempted. Instead, fine workmanship, backed up with the best quality of materials in every part as required by good engineering was the policy in designing the MCR filter.

Economy in operation with a resulting cost saving quickly discounts the price appeal of some other filters. In many installations the labor saving alone has paid for the MCR filter in six months.

Simplified, fingertip controls and features such as the retractable tank with smooth hydraulic power operation, eliminating the time and labor wasted in breaking pipe connections and outlet seal in opening the filter; the exclusive Sparkler MCR plate design that produces exceptionally high flow rates with unmatched durability; are examples of many design innovations found in this filter.

Almost every filtering job needs special application of filtration engineering principles and you can get this service at Sparkler. Sparkler has made rapid advancement in engineering and manufacturing of new filtration equipment for the chemical, sugar, beer, water, pharmaceutical, and many other industrial fields. Some of the largest plating plants in the world use Sparkler filters esclusively.

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YOU CAN DEPEND ON THE Richardson E-50!

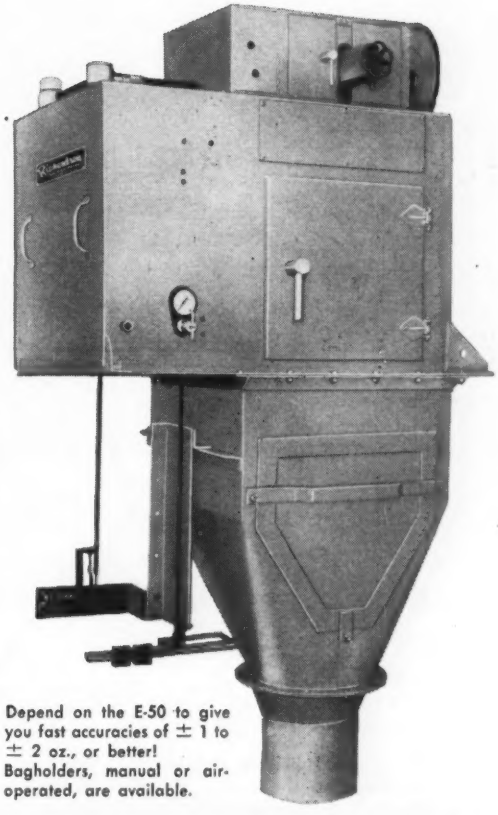
When the weighing is fast and the materials are loose (or even sluggish!), and you're having a running battle with profit loss from weight inaccuracy or the high cost of bagging and scale upkeep . . .

here's one scale that won't let you—or your profits—down!

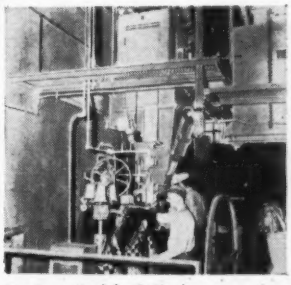
IT'S DEPENDABLE! The E-50's work-horse dependability makes it the perfect choice for any plant *where output vitally depends on the perfection of the bagging scale.* And upkeep is low! You'll find Richardson Scales still in operation after 30 and more years of service.

IT'S FAST, ACCURATE! With the rugged, completely automatic Richardson E-50 you'll get high speed bagging with accuracies *that never before were a practical possibility*—up to 1/10 of 1% under optimum conditions.

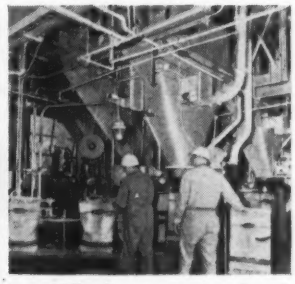
IT'S VERSATILE! Unique design permits the weighing of hundreds of food, chemical, grain and other materials. The E-50 is equally efficient as an independent bagging machine, or as an integral part of a co-ordinated production line packaging system. Don't let weight inaccuracy and bagging costs pick your pockets. Find out about the scale that really unties production tie-ups—Richardson E-50. Write today for free illustrated bulletin #3749A that tells the whole cost-saving E-50 story!



Depend on the E-50 to give you fast accuracies of ± 1 to ± 2 oz., or better! Bagholders, manual or air-operated, are available.



Duplex Model E-50 bags poultry mash up to twenty-two 50-lb. bags per min. at leading feed mill.



Ten 50-lb. bags per min. of antibiotic are delivered from Duplex E-50 in major pharmaceutical plant.

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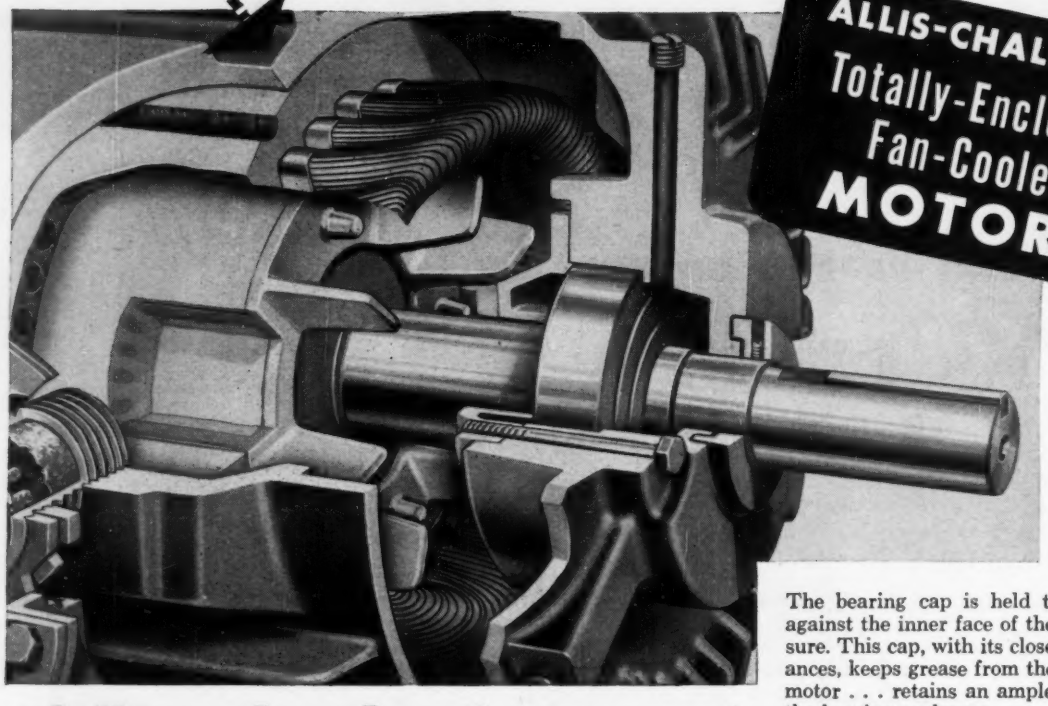
Get Both bearing features



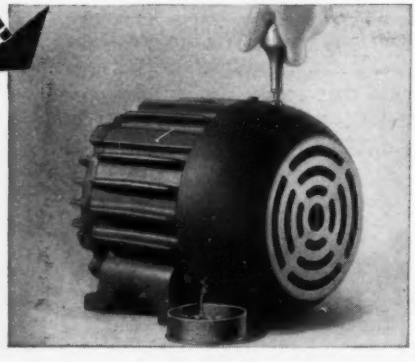
fully enclosed and protected

The bearing cap is held tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

. . . yet easy to grease

You can lubricate the bearings without dismantling the motor. Pipe-tapped holes in the bearing housings at three points provide both means for inserting new grease and a means of flushing out old grease.



Look for the extra bolts on the end housing . . . the sign of greater value. Ask your Allis-Chalmers representative or Authorized Distributor to show you a cutaway section of this maintenance-cutting design. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B7225.

A-4609

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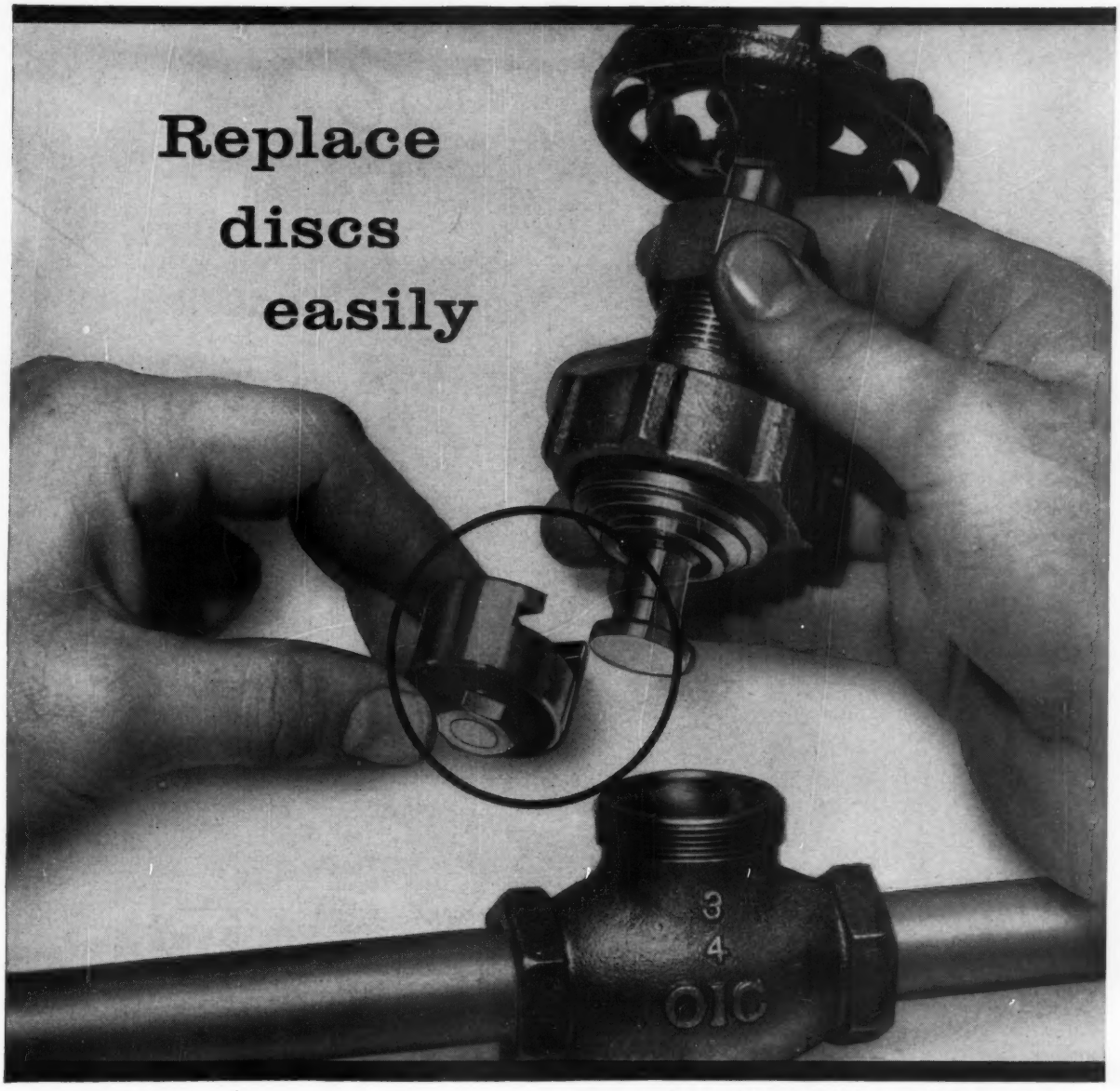


Fig. No. 520, 200 lbs. WSP, @400°F. 400 lbs. cold WOG, non-shock

It takes two minutes or less! Simply break the union joint and slip a replacement disc holder onto the button-head of the stem. Or, replace the disc only.

Additional features of this OIC line greatly reduce the need for other maintenance. For example: (1) The modern union body-bonnet joint assures a safe, tight, leakproof seal which is not affected by frequent dismantlings. (2) The special OIC *alloy-40* stem material eliminates galling and seizing. (3) Molded, graphite-asbestos, plastic packing is used which seals without hardening or cracking in service.

Reduce your valve problems by installing this OIC line wherever you need bronze globe and angle valves with composition discs. Call your OIC Distributor for more facts, or write for Form No. 1001 which describes the entire OIC 500 line with composition discs, as well as spherical and plug-type discs in globes, angles and checks.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

VALVES | **FORGED & CAST STEEL, BRONZE & IRON, LUBRICATED PLUG VALVES**

P-508

Suspended magnet solves tramp iron problem on high-speed conveyor handling wet or dry material

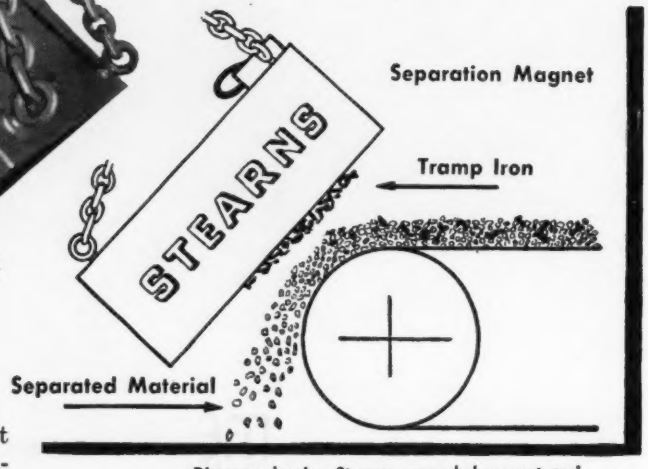


Diagram showing Stearns suspended magnet positioned over head pulley.

Stearns rectangular suspended separation magnet cures tramp iron headaches on fast-moving conveyors, particularly when material is wet.

First, the magnet's length permits its powerful, deep pulling force to work over a large area . . . dig out embedded tramp iron . . . prevent "sneak throughs." Second, the upward movement of iron to the magnet, shakes off wet, clinging material, eliminating costly waste.

Greater Flexibility

Stearns suspended magnet overcomes space limitations because it can be placed over the head pulley, or anywhere along the belt. Sometimes it's set up to remove tramp iron before material moves onto the conveyor — thus safeguarding the belt from damage. In many processing operations, Stearns suspended magnets are used ahead of magnetic pulleys to insure double protection for crushers and other expensive equipment.

Custom-Built

Magnetic specialists at Stearns design and build rectangular or circular suspended magnets, electro or permanent magnetic pulleys in standard sizes, or to your individual specifications. Get complete details from your Stearns representative or write for bulletin 25D.

Check these advantages

- All-welded, moisture-proof construction
- No moving parts that require replacing
- Single coil construction for magnetic field stability
- Leads and terminals fully protected against abrasion
- Vacuum-impregnated windings for long life, dependable operation

1115

MAGNETIC EQUIPMENT FOR ALL INDUSTRY

STEARNS MAGNETS

STEARNS MAGNETIC, INC., 629 S. 28th St., Milwaukee 46, Wis.

Could this mean a **FORTUNE** to you?

. . . This white powder is ALCOA Alumina—aluminum oxide—a versatile chemical product that has helped to build success for ingenious manufacturers.

ALCOA Alumina presents properties that are indeed stimulating to scientists, researchers and development engineers—properties that open the door to possibilities in numerous fields.

For example, ALCOA Alumina has an extremely high melting point (3,704° F). This property alone has opened up high-temperature applications once thought impossible—super-refractories, insulators for automotive and jet engine spark plugs, and many more.

ALCOA Alumina is a crystalline material with very sharp edges and corners, from which it derives its value as a fast-cutting abrasive. Moreover, it is exceptionally hard (9 on Moh's scale), providing such good abrasion resistance that it is now used where once even strong metals failed—in pipe linings, forming dies, thread guides, grinding mills.

The list of successes could be expanded almost without end. Tooth paste, whiteware, dehydration and catalytic processes, glassware, ceramic tile, bearings, concrete—*all* have been measurably improved by ALCOA Aluminas.

ALCOA Aluminas have a habit of making money for manufacturers. Almost every day someone puts them to work on profitable—often amazing—applications. Why not investigate ALCOA Aluminas? They *could* mean a fortune to you.

For further information and samples to test in your own plant, write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 702-J Alcoa Building, Pittsburgh 19, Pa.

ALCOA CHEMICALS
ALUMINUM COMPANY OF AMERICA

NEW! ASHCROFT 2½" GAUGE

HAS TYPE 316 STAINLESS STEEL SYSTEM TO WITHSTAND CORROSIVE CONDITIONS

High resistance to corrosion and sustained high accuracy are combined in this new heavy-duty Ashcroft Gauge. The 2½" dial size makes this compact instrument ideal for small tanks and processing equipment where large pressure gauges would be impractical. Bourdon tube (welded at socket and tip) . . . square shank and ¼" male N.P.T. bottom connection . . . geared movement—the entire gauge system is Type 316 stainless steel.

Made in standard graduations from 30 psi through 1,000 psi, this new Ashcroft Pressure Gauge has a black dial with easy-to-read white figures. The drawn steel case and threaded ring are finished in black. Pointer is precision needle type. Every part is designed, tested and manufactured to meet rigid service conditions.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR now has this new Ashcroft Gauge in stock. Let him know your requirements. You can depend on him for experienced counsel and prompt delivery.

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

1850 ASHCROFT U.S.A

ASHCROFT GAUGES

MAXWELL MANNING MOORE TRADE MARK

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

what is your PULVERIZING problem?

we'll test grind a sample for you with the SCHUTZ-O'NEILL Superfine PULVERIZER

What is your milling problem—uniformity? fineness? Do you need increased output at a lower cost? Without obligation to you, we'll grind a sample of your material in our pilot plant, using a production model Schutz-O'Neill "Superfine" Pulverizer. We'll return your processed product with our Engineering Test Report giving exact data and including recommended Schutz-O'Neill equipment, methods and mill plans for your job.

This will give you full information on the versatility, particle size range and capacity of Schutz-O'Neill "Superfine" Pulverizers. Backed by more than 60 years of continuous manufacturing and field experience.

SCHUTZ-O'NEILL PILOT PLANT uses a standard production model 16" Superfine Pulverizer. Mill components on wall at left in photo provide up to 100 different pulverizing setups, with a range from 40 mesh to 5 microns.

Below are two typical pulverizing problems that were solved by SCHUTZ-O'NEILL

NO. 1 PULVERIZING CERAMIC MOLDING MATERIALS

THE PROBLEM: To develop ceramic materials for precision molding of high temperature, high fidelity alloy castings for jet aircraft engines. Castings of molybdenum, columbium, and other rare metals were to be made. By producing precise castings, less machining is required and more rare metal saved. The particle size for best results (determined by university consultants) fell within the 60 to 200 mesh range.

THE TESTS: The Schutz-O'Neill pilot plant processed 200 pounds of the feed material, in a series of tests with the university ceramic consultants and the contracting firm present.

THE SOLUTION: Schutz-O'Neill designed a system that is now producing 1,000 to 1,200 pounds per hour of ceramic material 85 to 90 percent within the required 60 to 200 mesh range.

NO. 2 PIGMENTS UNDER 25 MICRONS FOR COLORING PLASTICS

THE PROBLEM: A leading chemical firm producing a variety of resins and plastics wanted to reduce and intimately blend pigments for coloring molded plastic forms. The manufacturer found that particles larger than 25 microns produced streaks in the finished molding. In addition, tints prepared from more than one color necessitated absolute dispersion and optimum blending to insure proper shading and depth.

THE TESTS: Pilot plant test runs were conducted at Schutz-O'Neill. The resulting product was analyzed in the manufacturer's lab. In their report to Schutz-O'Neill, the firm stated, "In all our tests your grinder was equal to or better than the others from the standpoint of fineness of grind and absence of pigment specks in our product".

THE SOLUTION: The chemical firm is being supplied with a 22" Schutz-O'Neill stainless steel Pulverizer.

Write Us:

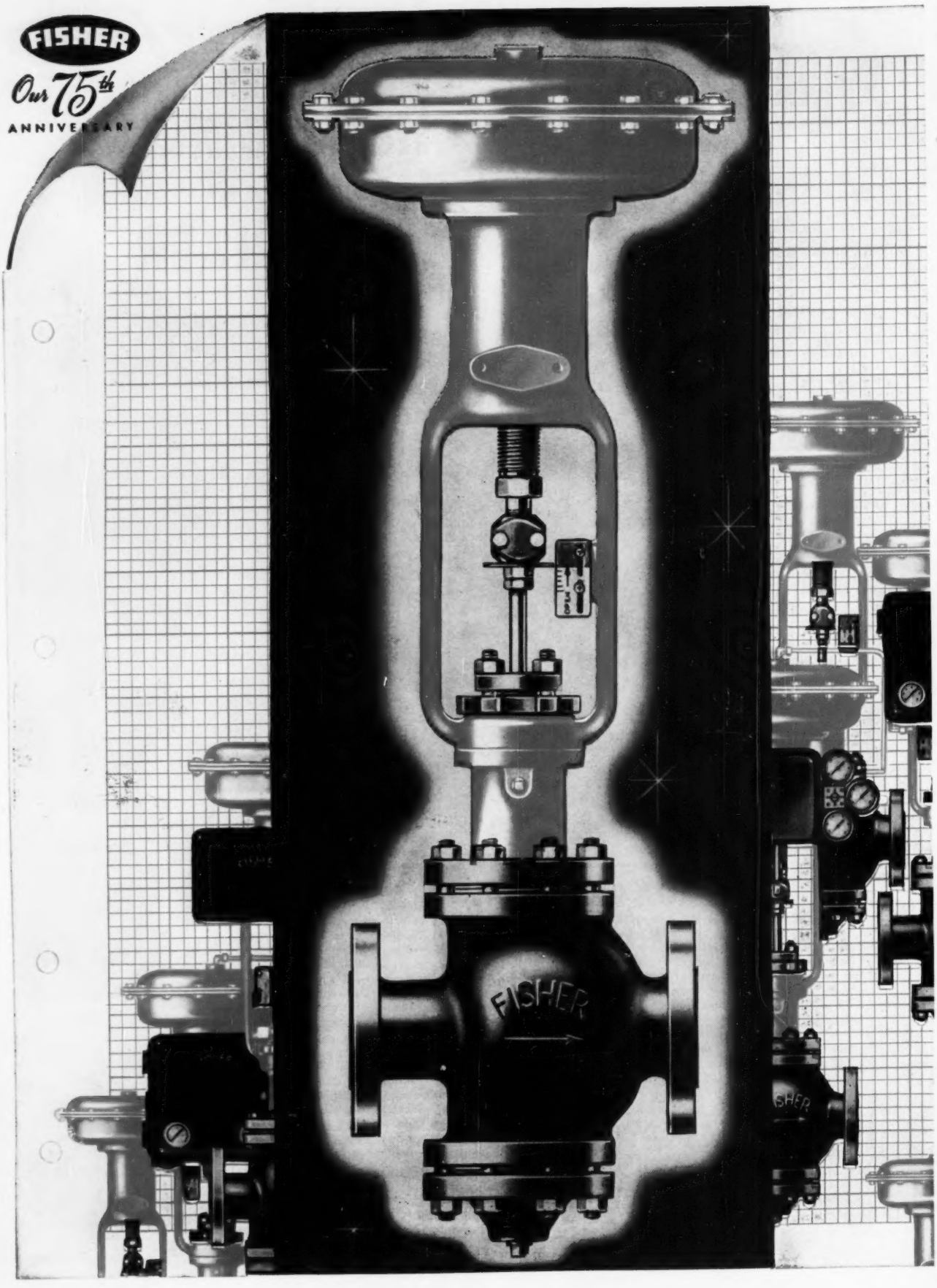
Tell us the stock you want to pulverize, fineness, capacity desired; we'll send shipping instructions. Or, write for literature desired on Schutz-O'Neill Pulverizers, Granulators, Roller Mills, Sifters, Cyclone Collectors, Hammer Mills.

ESTABLISHED 1893

SCHUTZ-O'NEILL COMPANY

PULVERIZERS • GRANULATORS • ROLLER MILLS • CYCLONES • SIFTERS • HAMMER MILLS

301 PORTLAND AVENUE • MINNEAPOLIS 15, MINNESOTA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Our 75th
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FISHER®

Presents An Improved

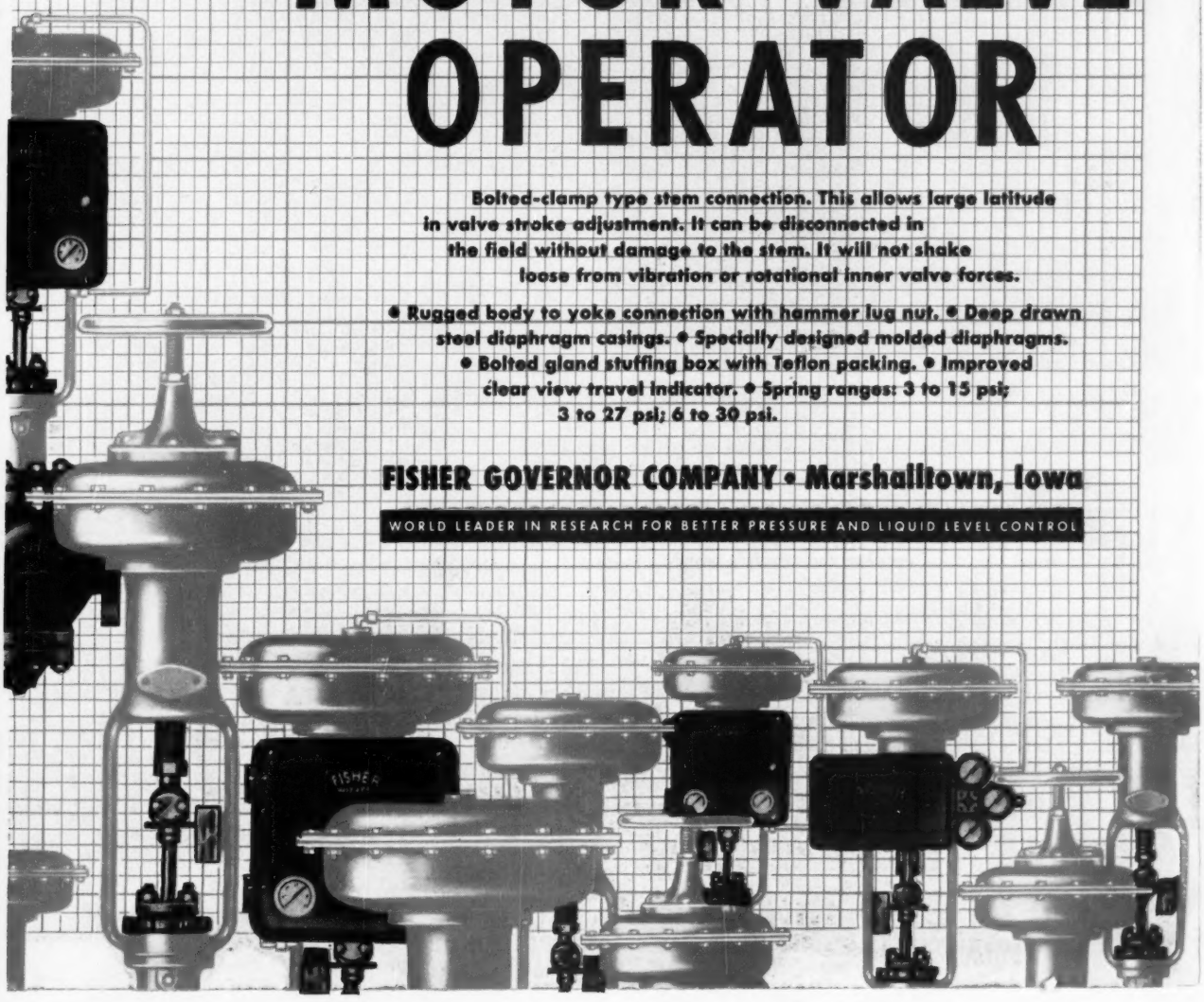
DIAPHRAGM MOTOR VALVE OPERATOR

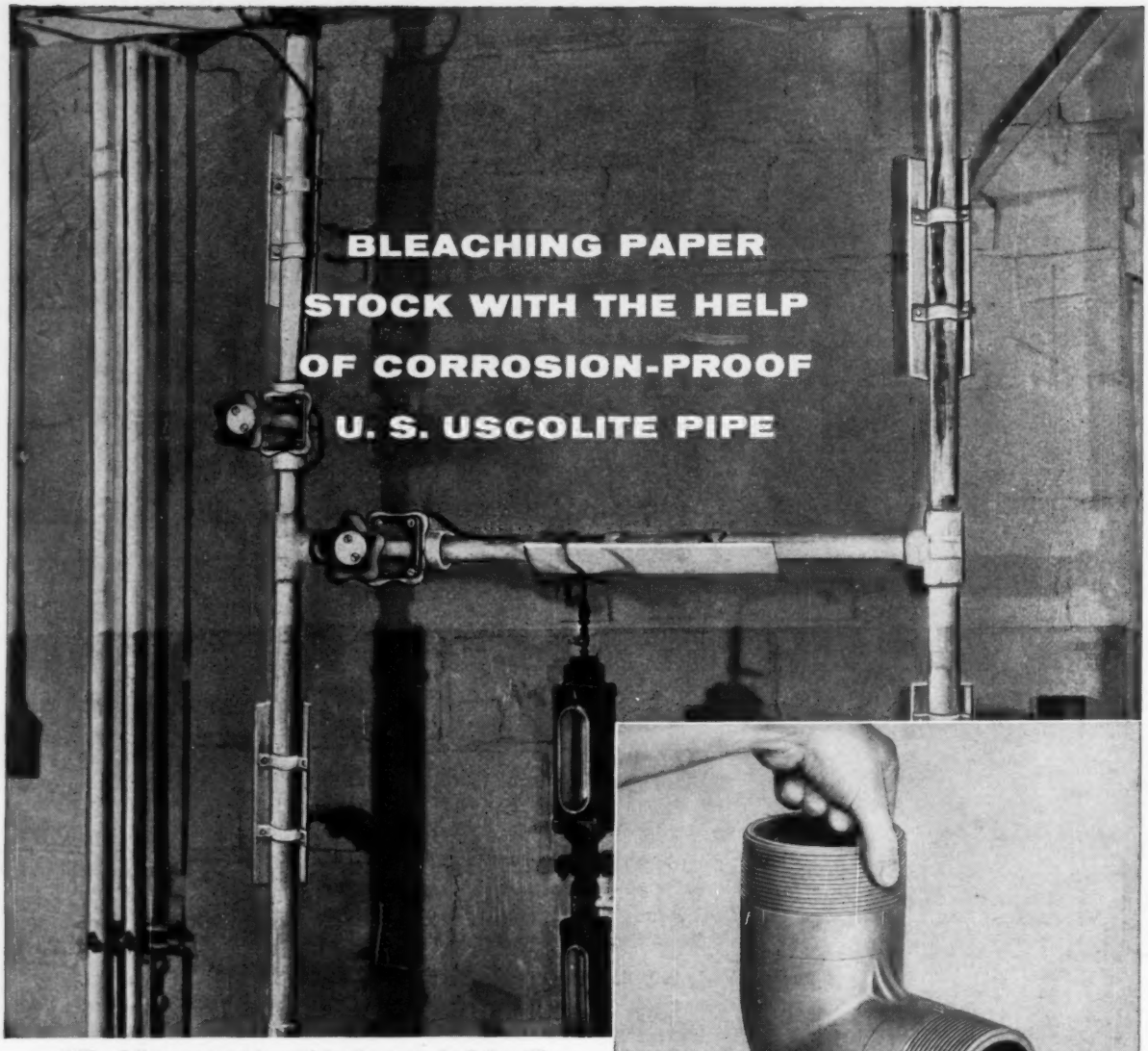
Bolted-clamp type stem connection. This allows large latitude in valve stroke adjustment. It can be disconnected in the field without damage to the stem. It will not shake loose from vibration or rotational inner valve forces.

• Rugged body to yoke connection with hammer lug nut. • Deep drawn steel diaphragm casings. • Specially designed molded diaphragms. • Bolted gland stuffing box with Teflon packing. • Improved clear view travel indicator. • Spring ranges: 3 to 15 psi; 3 to 27 psi; 6 to 30 psi.

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL





Milk of lime rotameter, used in the control of the pH of the stock in a double-shaft mixer. The piping is U. S. Uscolite with Uscolite (Hills-McCanna) valves.

The paper mill, located in Pennsylvania, selected U. S. Uscolite® plastic pipe because it's immune to the corrosive chemicals used in the bleaching process, and requires *no upkeep*. The piping previously used just couldn't stand the gaff.

Made by United States Rubber Company, Uscolite is an extremely tough but lightweight thermoplastic pipe. It imparts no odor, taste or discoloration. It is threaded and assembled with ordinary piping tools—*without* special preparation. Uscolite is in use in thousands of installations in every industry where constant control of chemicals, acids or corrosion is a problem.

Uscolite pipe and fittings are made in the broadest and largest line of stock sizes on the market. Sizes run from ½" to 6".

For replacement or completely new piping, get in touch with any of the 27 "U. S." District Sales Offices or write to address below. Immediate delivery of standard sizes and threaded fittings. The Hills-McCanna Uscolite valve is available for your piping assembly.

"U. S." Research perfects it

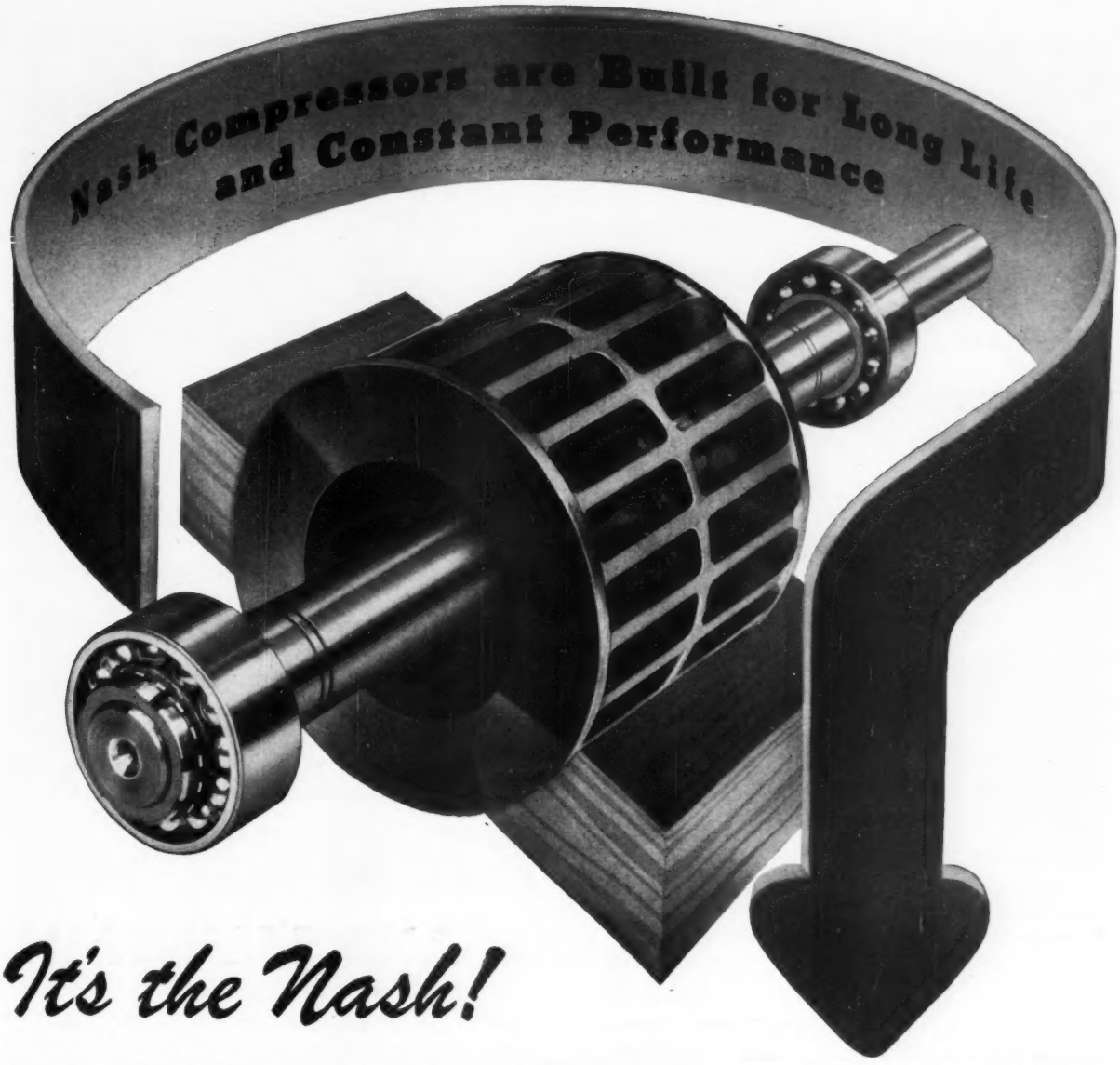
"U. S." Production builds it

U. S. Industry depends on it.

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting



It's the Nash!

The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintains 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

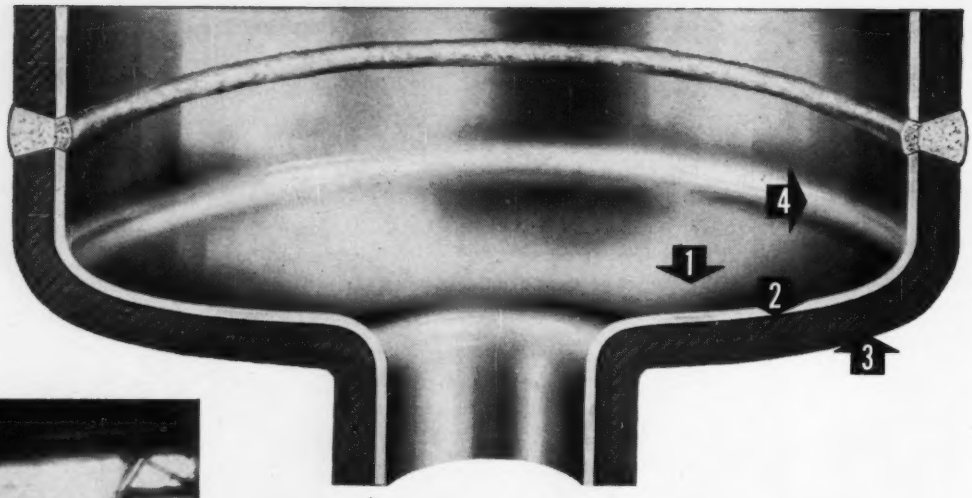
Desired delivery temperature Automatically maintained.

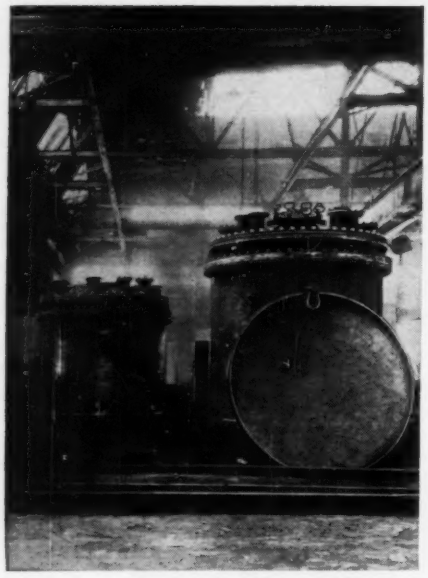
Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

312 WILSON, SO. NORWALK, CONN.





These chemical reaction tanks were fabricated from wide plates of Nickel-Clad Steel.

1. **ECONOMY**—High-alloy layer—usually 10% or 20% of total plate thickness—assures corrosion and abrasion resistance, long equipment life.
2. **DESIGN FREEDOM**—Integral bond allows design and fabrication of shapes to meet process and space needs.
3. **STRUCTURAL STABILITY**—Carbon or alloy steel backing gives required strength and rigidity at lower cost.
4. **LESS MAINTENANCE**—Smooth, hard surfaces, rounded corners and sloping bottoms mean easy cleaning and draining.

CLAD STEEL EQUIPMENT IS EASIER TO CLEAN AND MAINTAIN

Where cleaning and maintenance problems hamper continuous operation, slow down process change-overs or run production costs up, corrosion-resistant clad steel equipment can provide the *economical* solution. Clad's smooth, high-alloy surfaces are virtually maintenance-free, often need only to be flushed with water. Where drastic cleaning methods must be used, the clad surfaces won't chip or peel. Because of the permanent bond between cladding and backing, tanks and vessels may be designed with the rounded corners and sloping bottoms that assure quick, easy drainage.

There are sixteen Lukens' Clad Steels—various types of stainless, nickel, Inconel, Monel, copper. They give you corrosion and abrasion resistance, protect product purity to the same degree as solid high alloys with savings of up to 50% in material costs. The ASME Code permits full gage consideration for design purposes because cladding and backing are bonded over their entire surface.

To get these benefits, plus long life under pressure, vacuum or thermal cyclical service, fast heat transfer and easy modification when processes change, ask *qualified* builders about clad steel equipment. These men are experts, understand your problems, and will work with your engineers and consultants. We offer the widest selection of clad steels available anywhere and we can help in the selection of the type of clad steel that best suits your needs. If you would like more information, consult one of your equipment builders, or write Manager, Marketing Service, Lukens Steel Co., 749 Lukens Building, Coatesville, Pa.

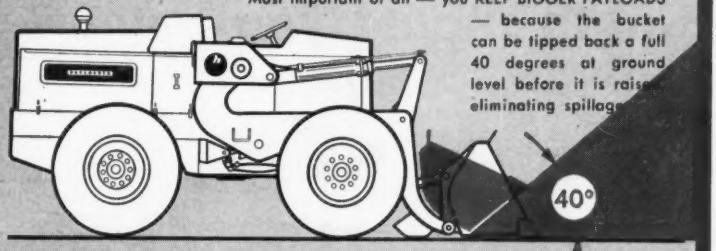
LUKENS CLAD STEELS

STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEEL PLATES AND HEADS AVAILABLE

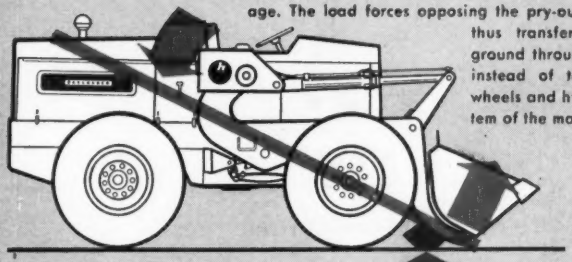
Only these 2 completely new PAYLOADER® tractor-shovels offer you all these features

the NEW
Model HU 1 cu. yd.
Model HH 1½ cu. yd.



You can get HEAPED BUCKET LOADS and you get them FASTER and EASIER with this new bucket action. Most important of all — you KEEP BIGGER PAYLOADS — because the bucket can be tipped back a full 40 degrees at ground level before it is raised, eliminating spillage.

40 Degrees BREAKOUT at ground level with Tremendous pry-out action



Tremendous pry-out force is obtained by using the breakout pads on the ground as a fulcum for leverage. The load forces opposing the pry-out action are thus transferred to the ground through the pads instead of to the axle, wheels and hydraulic system of the machine.

SAFETY and STABILITY

Understung boom-arm design keeps moving members out of operator's reach at all positions — without using safety guards and screens. Longer wheelbase and close, low, load-carry position provides maximum stability and balance.

HOUGH DESIGN
HOUGH QUALITY
HOUGH PERFORMANCE

more horsepower per bucket capacity than any other wheel tractor-shovel. Either gasoline or diesel power available.

easy to operate. Fullest operator visibilty for safe, fast maneuvering; power-steering; minimum number of control levers. Foam-rubber molded seat and back cushions. Seat adjustable for operator comfort. Longer wheelbase and better balance add to riding comfort.

accessibility. Unusual accessibility for servicing and maintenance. Battery and oil reservoir are located under an easy-access cover just behind driver's seat. Sealed grease fittings. Exterior hydraulic line outlet provided for easy addition of hydraulically-operated accessories.

torque-converter drive in conjunction with 4-speed, full-reversing transmission provides precise, easy control and the widest possible range of speeds for both forward and reverse. Acts as a shock absorber for the entire power train.

other features. Closed, pressurized hydraulic system keeps dirt and air out of oil; powerful hydraulic brakes; double-acting hydraulic cylinders and chrome-plated piston rods; 12-volt electric systems on gas-powered models; forward and backup driving lights; tail lights.

The Frank G. Hough Co.
754 Sunnyside Ave., Libertyville, Ill.

Send me full information on the new Model HH and HU "PAYLOADER" tractor-shovels.

☐ Model HU-1 cu. yd.
☐ Model HH-1½ cu. yd.

Name .....
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SAY "HUFF"

PAYLOADER®

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SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

caustic soda—

which strength should you buy?

Here are the facts to help you decide which saves you more—50% or 73%

Can you save by switching from 50 to 73% liquid caustic? Your answer will depend on:

1. Your caustic soda freight rate.
2. Your facilities for handling caustic.
3. The amount of caustic you use.

Advantages of 73% liquid

1. With 73%, there is a substantial saving in freight charges. 63% less water is shipped per unit weight of dry caustic soda.
2. You will place fewer orders. This cuts down on your billing work.

Disadvantages of 73% liquid

1. It is priced $2.00 more per ton (dry basis) than 50% because of higher manufacturing costs.
2. If you store it as 73% liquid, you will need heated, nickel-clad steel storage tanks.
3. If you dilute 73% to 50% while unloading, you will need a cooler and other equipment. This represents a considerable investment which can be reduced if you have suitable equipment already on hand.

Use this table to see if you can save with 73%

Use the table at right to find your approximate saving on freight charges with 73% liquid caustic. The table balances two cost factors . . . lower freight charges and the higher initial price of 73% liquid caustic.

To estimate your yearly savings, multiply the figure in the right-hand column which applies to you by your annual consumption in tons (dry basis).

From these savings you will have to deduct the cost of equipment for diluting to 50% while unloading.

Freight rate per hundred weight in cents (including taxes)	*Net savings per ton (dry basis) in dollars*
5	minus 1.40
10	minus .80
15	minus .10
16	0
20	.60
25	1.20
30	1.80
35	2.40
40	3.00
45	3.70

HERE'S HELP—WITHOUT COST

You gain much by choosing the *right* strength for your conditions. In coming to a decision, why not give yourself the advantage of unbiased expert technical help? A call to your nearest Hooker sales office puts at your disposal, without obligation, the experience gained in 50 years of supplying caustic soda to industry.

Your Hooker technical service man can show you what equipment you need for converting, and help you figure your exact savings. Why not phone or write him today at the nearest Hooker office?

* * *

"CAUSTIC SODA BUYER'S GUIDE" is the title of a new pocket-size booklet we will be glad to send you. Contains helpful facts on the economics of 50% and 73% solutions; other forms of caustic soda; capacities of tank cars and other containers; useful shipping information. Write for a copy.

HOOKER CHEMICALS

4-1894

1905—Half a Century of Chemicals
From the Salt of the Earth—1955

HOOKER ELECTROCHEMICAL COMPANY

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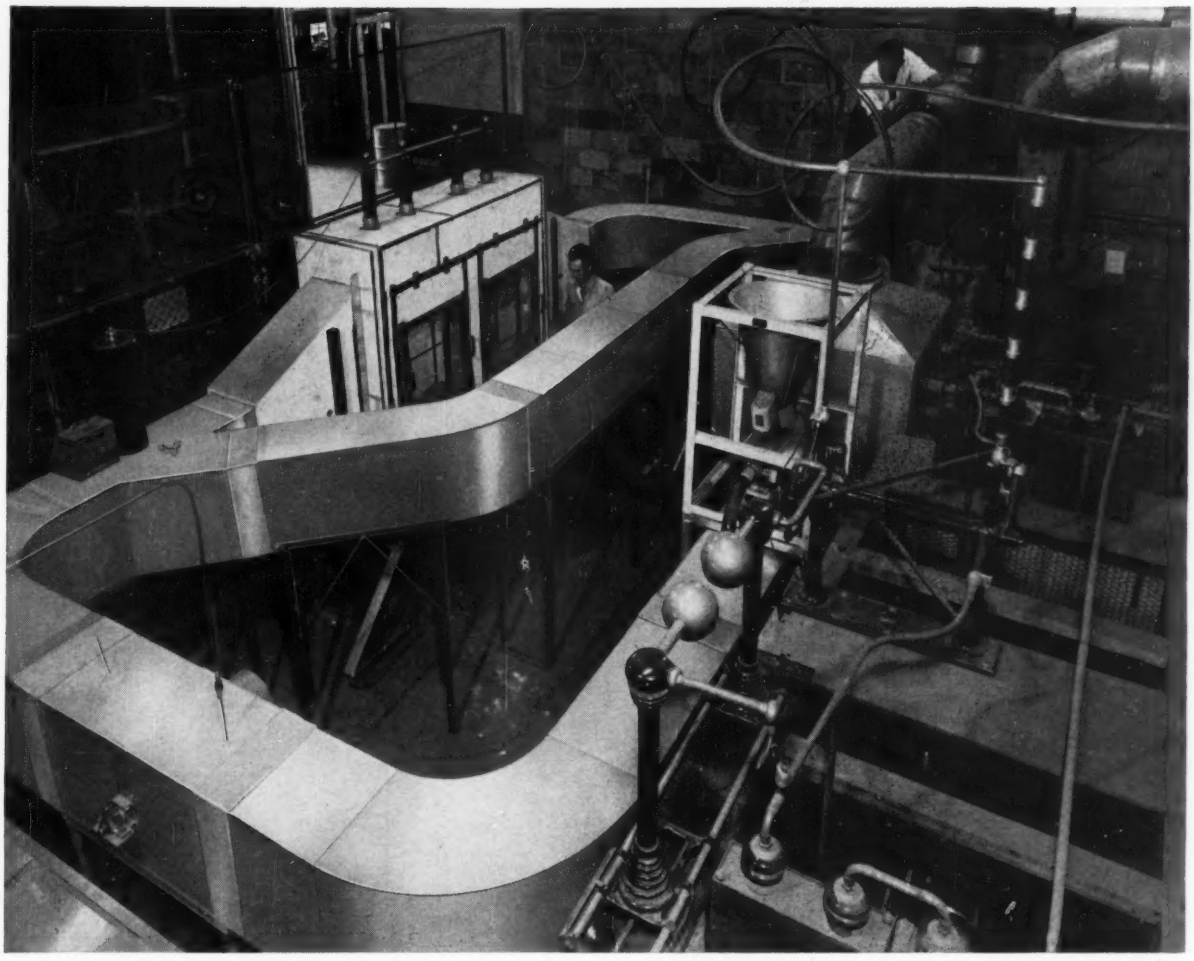
NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES



Precipitator pilot plant, Verona Research Center of Koppers Company, Inc.

Why Koppers Electrostatic Precipitators work so well

The answer to why Koppers Electrostatic Precipitators work so well is to be found in the sound engineering principles followed, from the project stage right through to actual installation . . . *application engineering "know-how."*

The wealth of experience gained over the years in designing and building equipment for cleaning gases provides the basis for such "know-how." In addition, foreign installation and engineering data is available to Koppers engineers through special agreements . . . Koppers experts are kept up-to-date on new process developments on a world-wide basis.

Koppers also has extensive laboratory facilities to analyze plant processes and problems in industrial gas cleaning. It has pilot equipment and competent personnel to conduct conclusive tests.

It's this knowledge, this experience, these facilities that make for satisfactory service . . . service for which Koppers has long been famous.

Next time you have a gas cleaning problem, remember that every problem is different, every problem contains variables which must be correctly analyzed before a satisfactory solution is reached. So it will pay you to consult Koppers . . . the company with *application engineering "know-how."* Mail this coupon for additional information.

KOPPERS®

ELECTROSTATIC PRECIPITATORS

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE 3, MD.
This Koppers Division also supplies industry with Fast's Couplings, American Hammered Industrial Piston & Sealing Rings, Aeromaster Fans, Gas Apparatus. *Engineered* Products Sold with *Service*.

KOPPERS COMPANY, INC., *Electrostatic Precipitator Dept.,* **219 Scott St., Baltimore 3, Md.**
Gentlemen: I am interested in an analysis and recommendations for my operation. I understand I am under no obligation.

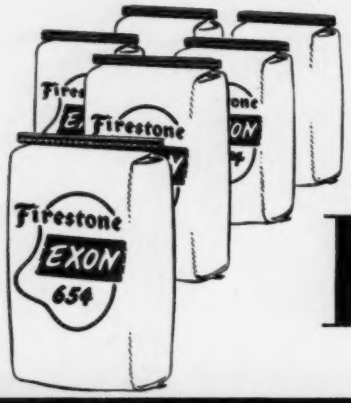
Name .....

Company .....

Address .....

City ..... Zone ..... State .....

EXON: each resin engineered for a specific problem



EXON 654

specifically for

Plastisols

No grinding needed when you use Firestone plastisol resin. An extremely fine powder with high molecular weight, EXON 654 readily disperses in plasticizer with simple stirring equipment.

EXON 654 is expressly created to impart excellent heat and light stability, physical toughness and chemical stability to your products.

Pastes formulated from EXON 654 show exceptional viscosity stability and flow properties. Unsurpassed for processing ease and efficacy in coating fabric and paper, they endow these products with unusual tear and wear resistance.

Whatever your particular problem, you're likely to find the specific remedy in one of the many EXON resins.

Firestone

EXON®

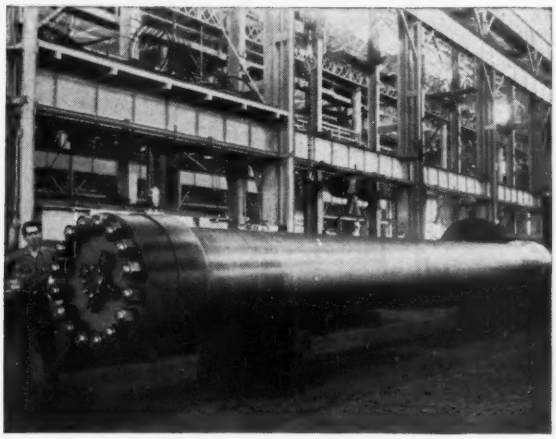
For complete information or technical service on the entire line of EXON *resins, call or write today.*

CHEMICAL SALES DIVISION

FIRESTONE PLASTICS COMPANY, POTTSTOWN, PA., DEPT. 28T

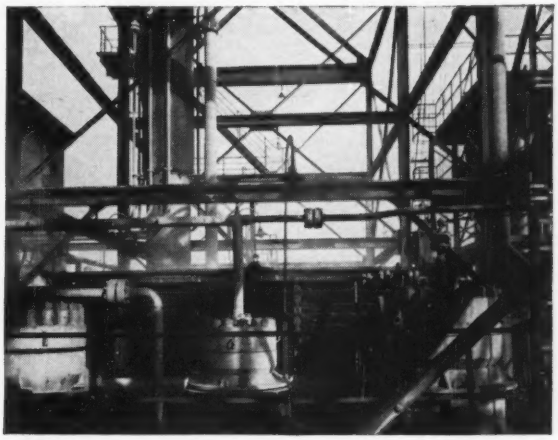
DIVISION OF FIRESTONE TIRE & RUBBER CO.

MIDVALE MAKES IT STRONG FOR AMMONIA



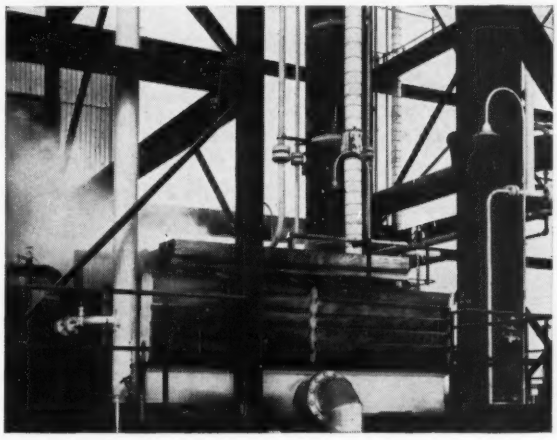
VESSELS START *RIGHT*

. . . at the Midvale furnace. The heads and the body of this ammonia converter were made from a combination of electric and open-hearth heats. This is typical of the ways in which Midvale uses its vast facilities to meet customer specifications.



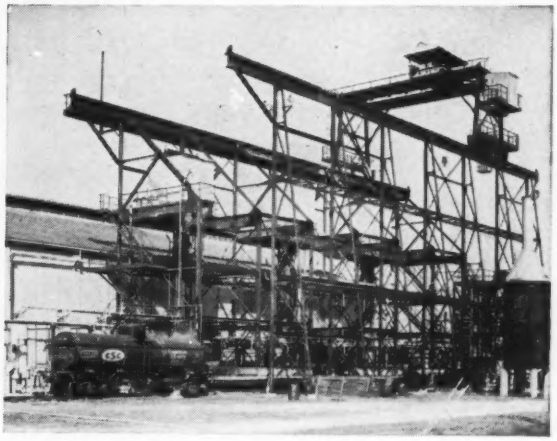
A FLAT HEAD AT EACH END

. . . requires leak-proof joints. Stud-bolts, 3¾" in diameter, hold these closures in place, and "delta type" gaskets . . . self-sealing under pressure . . . keep the joints tight. Midvale's close-tolerance, fine-finish machining of seat and gasket make such joints effective for the high pressures involved.



EXPERIENCE

. . . is necessary to produce this 42'7" vessel . . . shaped by equally experienced Midvale workmen who draw upon a half century of the company's experience in forging, and heat treated in closely controlled furnaces to develop physical properties capable of withstanding high working pressures.



THE COMPLETE PICTURE

. . . of Midvale has been developed through years of experience in making forged steel pressure vessels of many kinds . . . converters, reactors, separators, autoclaves. Midvale has men and equipment to make them to your specifications—for corrosion resistance, high temperatures and high pressures. Call Midvale next time. Let our engineers work with you from planning to installation.

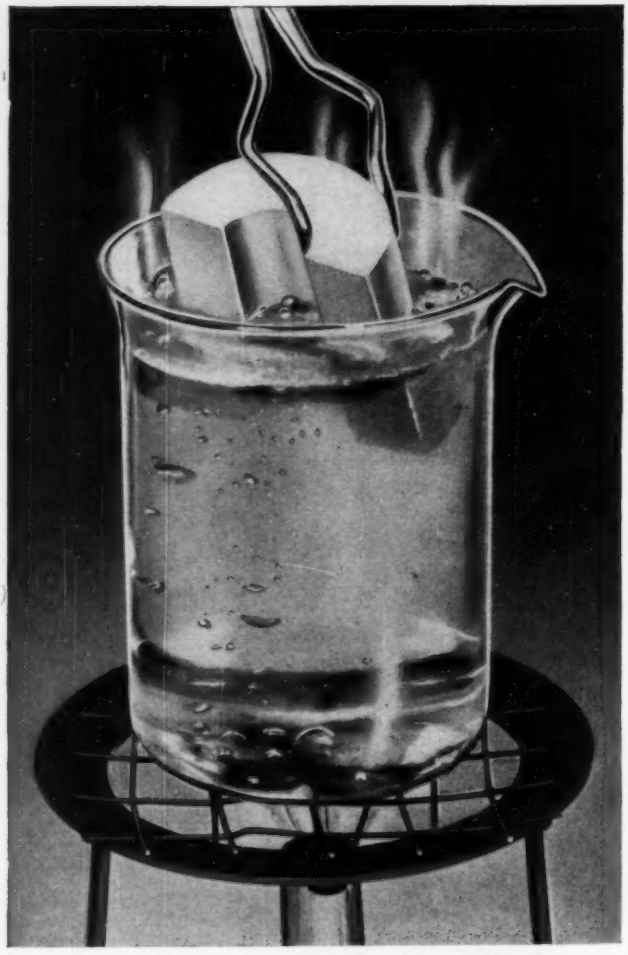
THE MIDVALE COMPANY- Nicetown, Philadelphia 40, Pa.

Offices: New York, Chicago, Pittsburgh, Washington, Cleveland, San Francisco

MIDVALE

FORGINGS, ROLLS, RINGS, CORROSION AND HEAT RESISTING CASTINGS

stability...



just one of many reasons why KAYLO® is the king of high temperature insulations

Other high temperature insulations may look like Kaylo—but performance brings out the difference. Take stability, for instance.

Even when soaked in water for long periods, or immersed in boiling water, Kaylo (hydrous calcium silicate) not only refuses to break down but, after drying out, shows no apparent shrinking or warping! And its original thermal efficiency and exceptional strength return, too! Moreover, it can be removed and replaced for line inspection without waste.

No wonder Kaylo is called "king of high temperature insulations!"

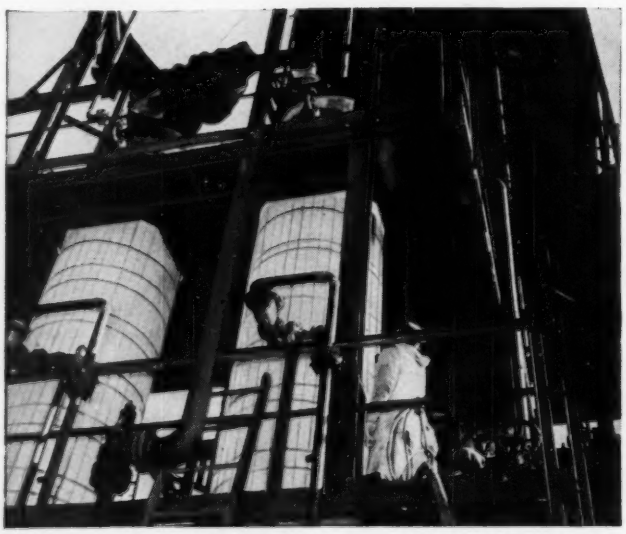
Together with Fiberglas*—the world's leading industrial insulation—Kaylo rounds out the most complete and versatile line of plant insulations available. It is distributed by Owens-Corning Fiberglas Corporation, and is made both as block and molded pipe insulation with the widest range of sizes, forms and thicknesses of any high temperature insulation.

For complete technical data, see our listings in Sweet's File, Chemical Engineering Catalog, or Refinery Catalog. Or write: Owens-Corning Fiberglas Corp., Dept. 97-I, Toledo 1, Ohio.

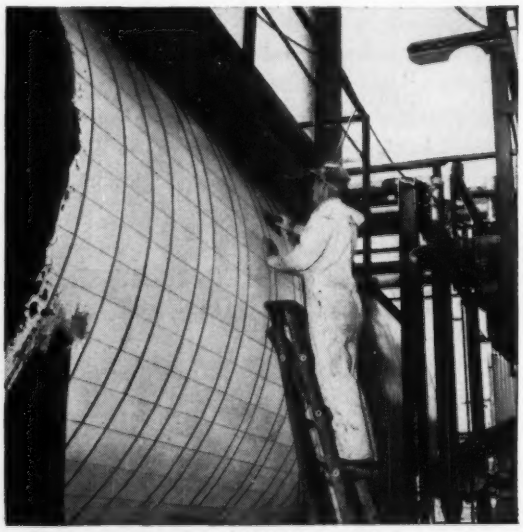
Kaylo and Fiberglas now provide you with complete coverage from lowest sub-zero to 1200° F—from one reliable supplier.

OWENS-CORNING
FIBERGLAS

* T. M. Reg. Owens-Corning Fiberglas Corporation
® Kaylo is mfd. by Owens-Illinois Glass Co., Inc.



Kaylo on a pair of "strippers" in a fractionating plant, one of an increasing variety of industrial applications.



Kaylo block on desalter tank. Strength of material and large units mean more economical application, less waste.

This detailed line drawing of the new, patented Veelos TD and TE v-belt makes it easy to see how this new v-belt is designed to do a better job . . . easier!

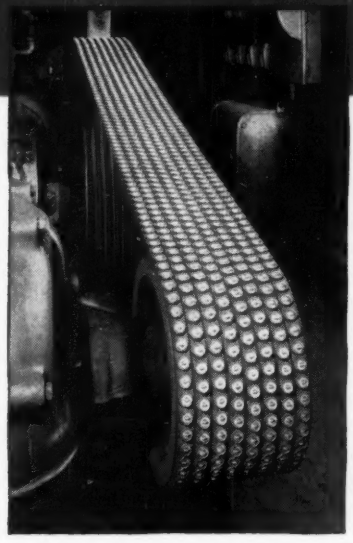
Link is beveled for extreme flexibility.

T-screw is made for strength and for easy coupling and uncoupling.

Cup-washer is shaped to resist belt wear.

Individual link is designed for greater strength.

Stud is anchored permanently in the link for added durability.



New VEELOS

TD and TE Adjustable V-belt

So easy to couple *it installs in minutes*

So strong and durable *it lasts for years*

The new Veelos TD and TE adjustable v-belt is the successful development of a specific v-belt designed for a specific service—D and E drives.

This new Veelos TD and TE v-belt has these basic advantages . . .

It simplifies installation. Links are quickly joined by easy-to-use cup-washers and T-screws to make up individual belts. It's the easiest v-belt to couple and uncouple ever developed. And you don't need to waste time removing outboard bearings.

It lasts longer—is more flexible. New high-tensile strength link combined with new stud, cup-washer, and T-screw gives added durability. New link construction provides maximum flexibility for cooler, wear-resistant running.

Get the complete story of this great new v-belt for D and E drives. Send coupon now for new 8-page illustrated catalog.

VEELOS
THE LINK
V-BELT

Veelos is known as Veelink outside the United States.

MANHEIM MANUFACTURING & BELTING CO.
602 Manbel St., Manheim, Pa.

Please send copy of your new Veelos TD and TE v-belt catalog.

Name .....

Company .....

Address .....

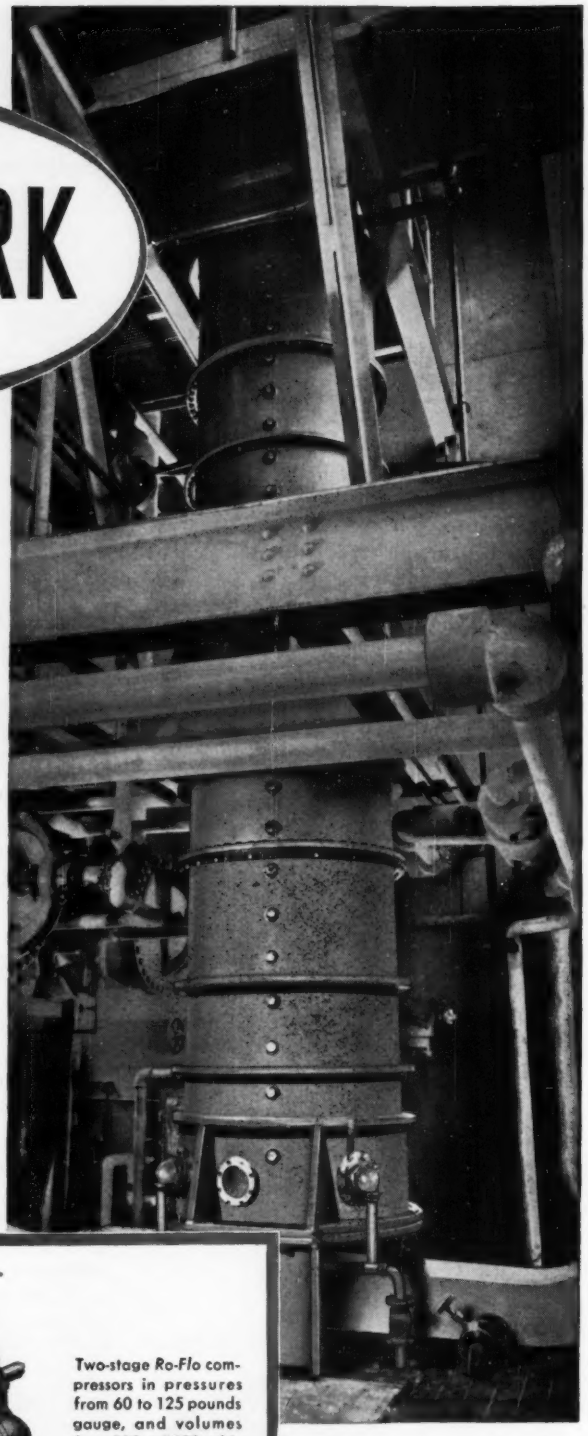
.....

207

ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

AIR AT WORK

New two-stage Ro-Flo compressor provides constant efficiency... cuts maintenance



Efficiency and air supply are constant year after year with *Ro-Flo* compressors. Even if wear occurs, it automatically compensates for itself so that air supply is unaffected.

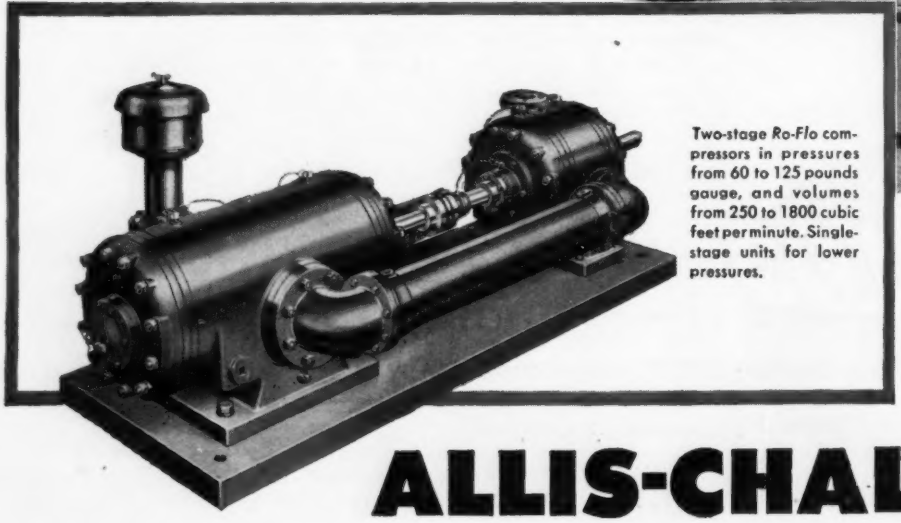
In addition, rotary design eliminates practically all vibration. No heavy foundations are needed.

Maintenance is cut too! There is no wear and tear from shock and vibration . . . no hard-to-maintain pistons and valves.

For constant efficiency . . . overall savings on air, modernize air supply with two-stage *Ro-Flo* compressors.

GET THE FACTS: Contact your A-C office or write Allis-Chalmers, Milwaukee 1, Wis.

Ro-Flo is an Allis-Chalmers trademark.



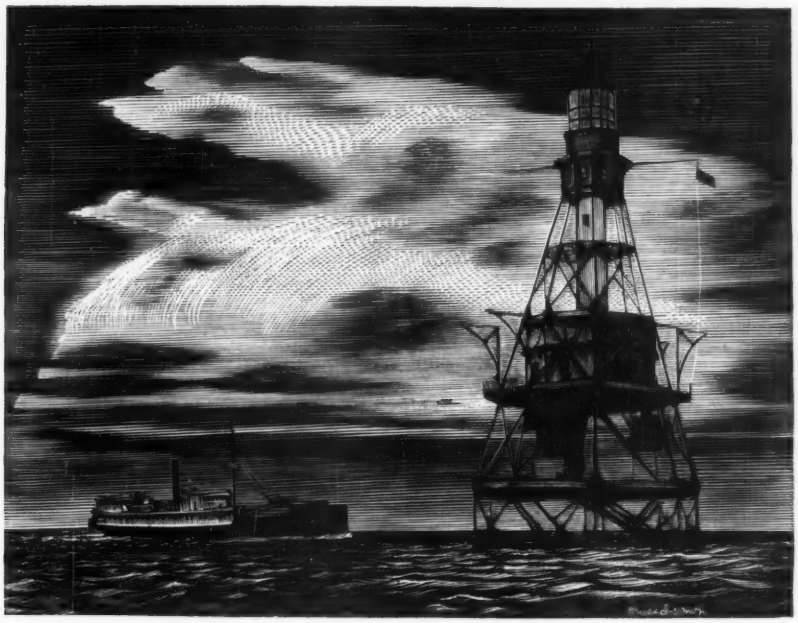
Two-stage *Ro-Flo* compressors in pressures from 60 to 125 pounds gauge, and volumes from 250 to 1800 cubic feet per minute. Single-stage units for lower pressures.

A-C ALLIS-CHALMERS

A-4739

ALLIS-CHALMERS

FAMOUS LIGHTHOUSES OF AMERICA



FOWEY ROCKS LIGHTHOUSE is situated on the outer reefs 11 miles southeast of Miami, Florida. Built in 1878, it is of iron pile construction and stands in 4 feet of water with the light itself 110 feet above water. Fowey Rocks Lighthouse is one of a series of great offshore lighthouses that have made navigation safer and helped to eliminate an infamous wrecking industry that once thrived along the dangerous Florida Reefs.

Greater Safety and true guidance in the use of electrochemical products have always been important factors in the service Niagara Alkali Company offers to its customers. You can always depend on the quality of Nialk® Liquid Chlorine, Nialk Caustic Potash, Nialk Carbonate of Potash, Nialk Paradichlorobenzene, Nialk Caustic Soda, Nialk TRICHLORethylene, Niagathal® (Tetrachloro Phthalic Anhydride).

NIAGARA ALKALI COMPANY

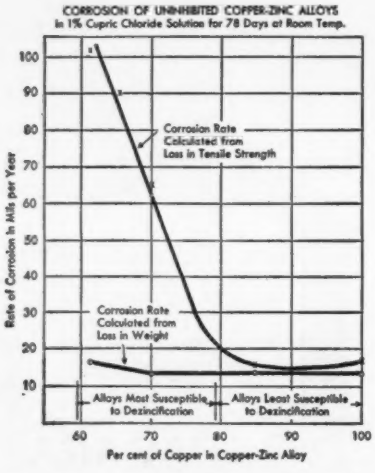
60 East 42nd Street

New York 17, N.Y.

BRIDGEPORT BRASS COMPANY
CONDENSER AND HEAT EXCHANGER TUBE EDITION
COPPER ALLOY BULLETIN
Bridgeport BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

How Inhibitors Retard Condenser Tube Dezincification

Dezincification in condenser and heat exchanger tubes occurs as zinc is lost from the copper-zinc (i. e., brass) alloy through corrosion. This lost zinc leaves as a residue, or by redeposition, a porous zinc-free mass of copper having very little mechanical strength. When the depth of corrosion is determined in uninhibited copper high-zinc alloys both on the basis of loss in weight and loss in tensile strength, a wide difference between the two final results is noted. This difference between weight and tensile strength is due to dezincification, which leads to only a relatively small loss in weight but a great loss in tensile strength as shown in the graph below.


CORROSION OF UNINHIBITED COPPER-ZINC ALLOYS
In 1% Cupric Chloride Solution for 78 Days at Room Temp.
Rate of Corrosion in Mils per Year
Corrosion Rate Calculated from Loss in Tensile Strength
Corrosion Rate Calculated from Loss in Weight
Alloys Most Susceptible to Dezincification
Alloys Least Susceptible to Dezincification
Per cent of Copper in Copper-Zinc Alloy

Conditions Causing Dezincification

Dezincification may occur when brass is exposed over prolonged periods to moist or wet conditions, especially to non-mineral, scale-forming fresh or salt water, when the brass contains less than about 85% copper and when a dezincification inhibitor is absent. Dezincification is especially promoted by (1) a limited supply of dissolved oxygen in the water, (2) the presence of certain salts, (3) a low water velocity or stagnation, and (4) elevated temperatures.

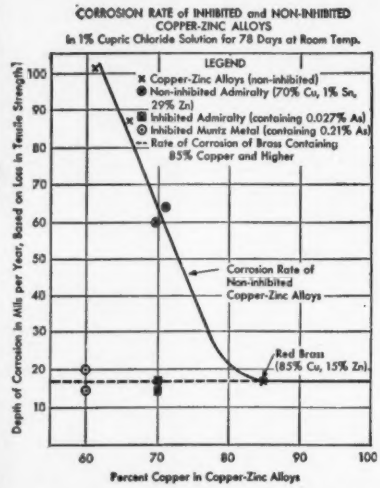
Mechanics of Inhibition

When arsenic is added to brass, dezincification and the redeposition of copper are retarded. Arsenic forms a film on corroding brass. As the thickness of this film increases, the electrical resistance of the film also increases. In electrolytic tests, it has been shown that this increase in resistance of the film leads to a decrease in the amount of current flowing through a cell to a point where the current drops to a small fraction of its initial value. The increase in potential is primarily due to the formation of the arsenic-rich film, the potential of the alloy shifting toward a more noble value which approaches that of copper.

Retarding Dezincification with Inhibited Alloys

Dezincification often can be prevented or retarded by regular mechanical or chemical cleaning, or a sufficiently high rate of turbulent flow which discourages the settling of corrosive deposits on the metal surface. The use of dezincification-inhibited alloys such as Bridgeport Arsenical Admiralty, Arsenical Aluminum Brass, and Arsenical Muntz metal provides a more satisfactory answer to this type of corrosion.

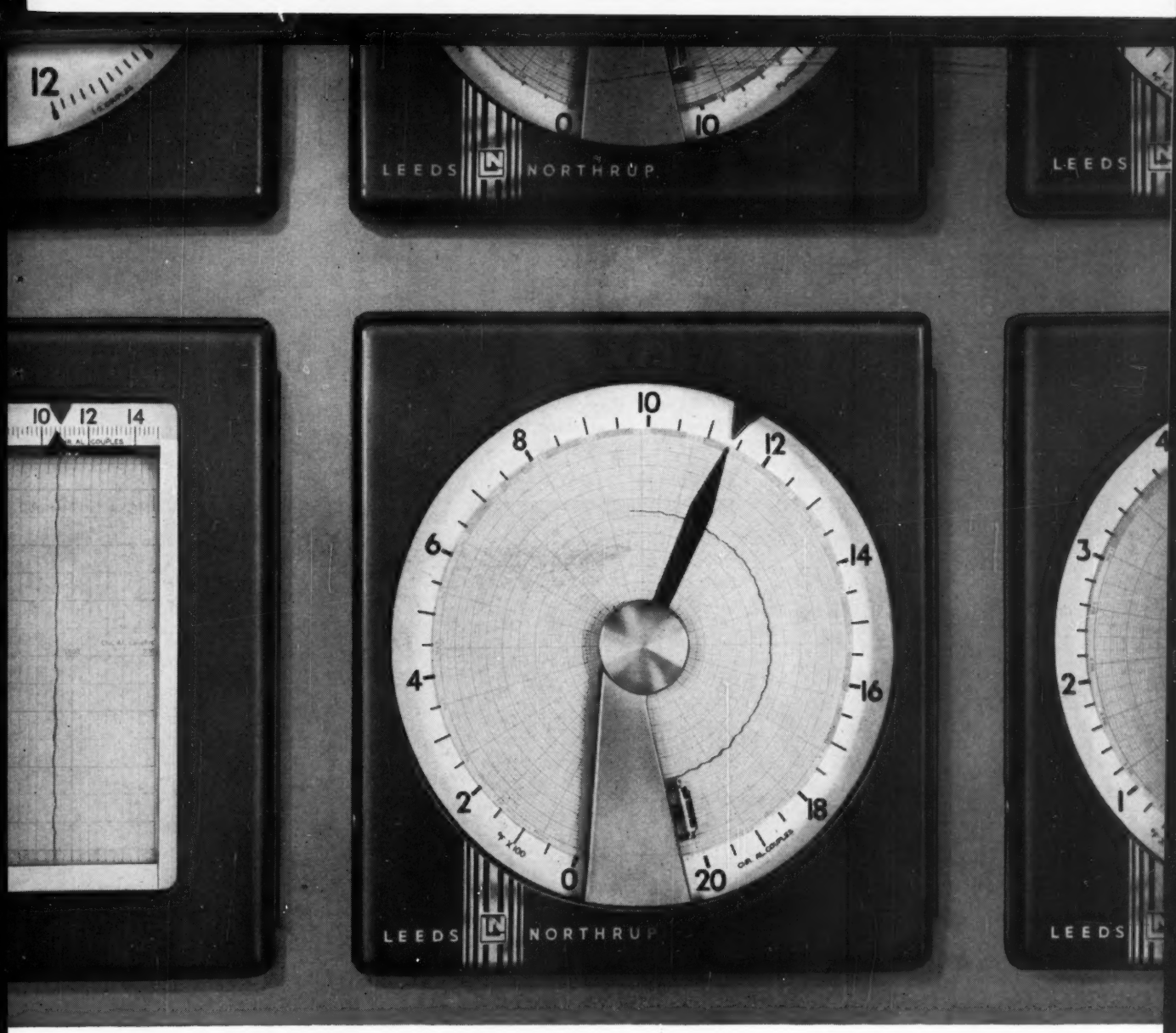
The difference in the rate of dezincification between inhibited and uninhibited brasses is shown in the following graph. The test results from exposure in flowing sea water are much in line with the laboratory test in 1% cupric chloride solution. The 1% solution was used because accelerated corrosion in this medium is comparable to that obtained in sea water over a much longer period. These tests were designed to give an accurate indication of what may be expected when inhibited brasses are exposed to cooling waters and the tests parallel closely actual service conditions.


CORROSION RATE of INHIBITED and NON-INHIBITED COPPER-ZINC ALLOYS
In 1% Cupric Chloride Solution for 78 Days at Room Temp.
LEGEND
Copper-Zinc Alloys (non-inhibited)
Non-inhibited Admiralty (70% Cu, 1% Sn, 29% Zn)
Inhibited Admiralty (containing 0.027% As)
Inhibited Muntz Metal (containing 0.21% As)
Rate of Corrosion of Brass Containing 85% Copper and Higher
Depth of Corrosion in Mils per Year, Based on Loss in Tensile Strength
Corrosion Rate of Non-inhibited Copper-Zinc Alloys
Red Brass (85% Cu, 15% Zn)
Percent Copper in Copper-Zinc Alloys

Bridgeport "Service-Matched" Condenser Tubes

Bridgeport's Technical Service and Corrosion Laboratory have acculmulated through the years extensive information on dezincification and other forms of corrosion. This knowledge is used in producing Bridgeport Condenser Tubes that help you prolong the service life of your equipment and cut the costs due to corrosion. That's why Bridgeport Condenser and Heat Exchanger Tubes are called "Service-Matched"—they are custom-engineered to meet your individual service requirements.

For helpful advice on the right Bridgeport "Service-Matched" Tubes for your application and technical help with your use of condenser and heat exchanger tube under various conditions of pressure, temperature and corrosion, call the Bridgeport office nearest you. Ask for your copy of Bridgeport's 156-page Condenser and Heat Exchanger Tube Handbook. (4018)



A new concept in panel space-saving . . .

less than 1 ft per unit

WITH SPEEDOMAX® H

● And that's the size of it . . . for a true null-balance potentiometer!

Only 11″ wide, Speedomax permits substantial savings in panel space . . . two of them can be mounted side-by-side in a 24 inch panel.

From the simplest indicator to the most complete standard controller . . . every Speedomax H combines this compactness with "big instrument" performance . . . outstanding simplicity of design with mechanical ruggedness.

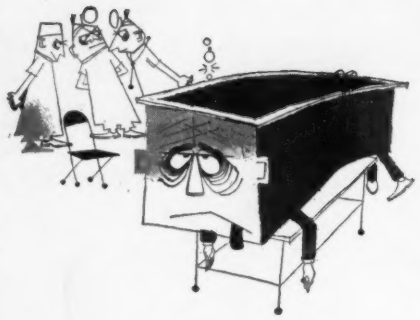
Speedomax H is available for a broad range of temperature measurements, including many now being made with non-potentiometer instruments. It is being supplied as an indicator, recorder or controller . . . with a round or strip chart . . . for two position or the type of proportioning control you select, mounted as an integral space-saving unit.

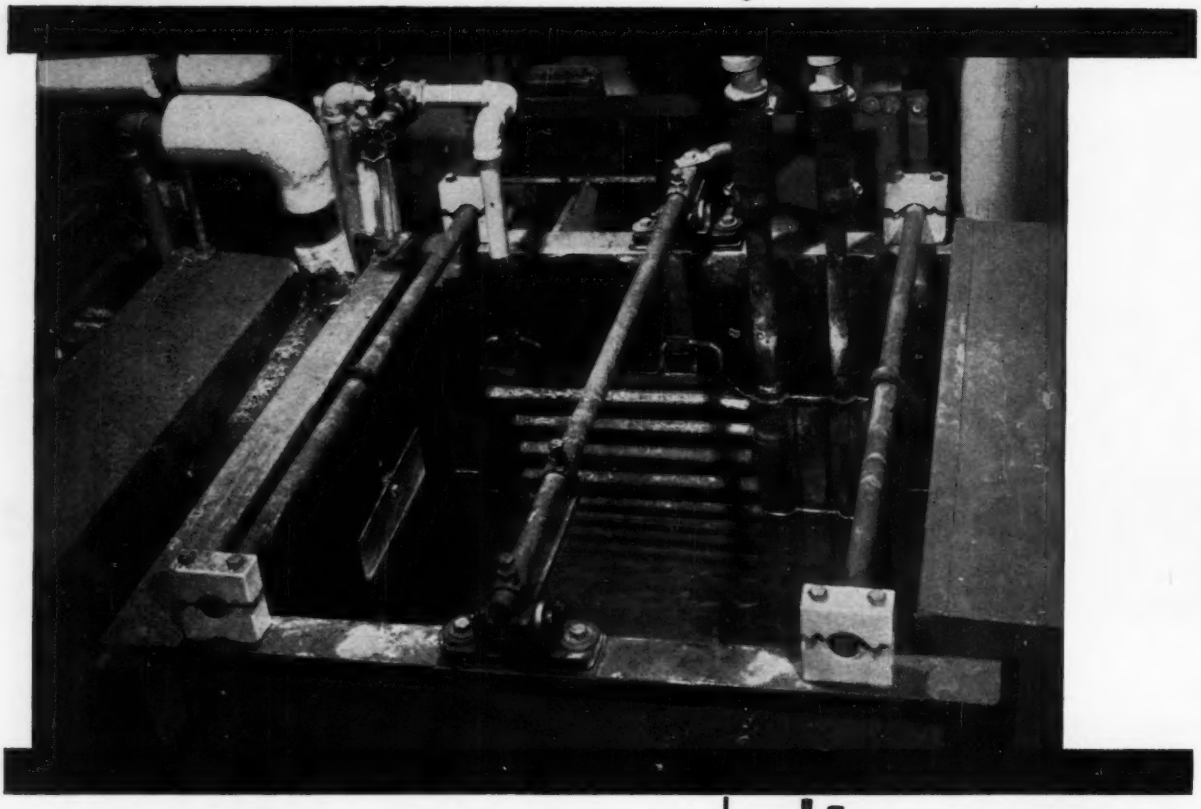
To see the features of this unique instrument, get our pictorial fold-out which takes you inside Speedomax H. Just phone your nearest L&N office or write us at 4916 Stenton Ave., Phila. 44, Pa. Ask for Die-Out ND46(1).

LEEDS NORTHRUP
instruments *automatic controls • furnaces*

new Wyandotte Research Laboratory uses PLATECOILS® to prevent coil-itis *

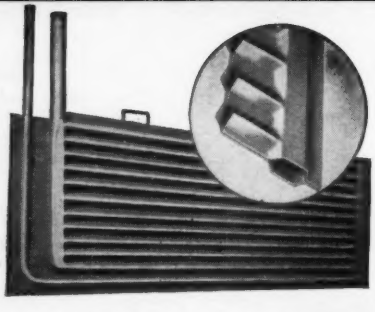
One of the finest technical laboratories in the country is the new Research Laboratory of Wyandotte Chemicals Corporation, Wyandotte, Michigan. A key feature of this laboratory is a series of 100-gallon plating and cleaning tanks made of various materials, such as rubber and plastic, which resist the actions of different types of chemicals. Individual tanks can be heated from room temperature to 212 degrees in less than an hour, by the Platecoil heat transfer units in the tanks. "We find Platecoil to be ideal because of their easy-to-clean surfaces and standardized performance," reports A. W. Liger, Supervisor of Industrial Research.





PLATECOILS replace pipe coils for 50% of the cost

* Coil-itis is the constant doctoring of wet processing tanks for pipe coil troubles. It can be cured easily by replacing pipe coils with Platecoils. Immediately, you will notice the difference as Platecoils put new life and profits into your heat transfer processes. They heat or cool 50% faster and take 50% less space in the tank. They save as much as 50% in initial cost and 50% in maintenance costs in addition to overcoming the limitations and operating difficulties of old fashioned and outmoded pipe coils.



Bulletin P61 shows how Platecoils are replacing pipe coils at a savings throughout industry. Send today for your copy.

PLATECOIL TRANTER MANUFACTURING, inc., Lansing 4, Michigan

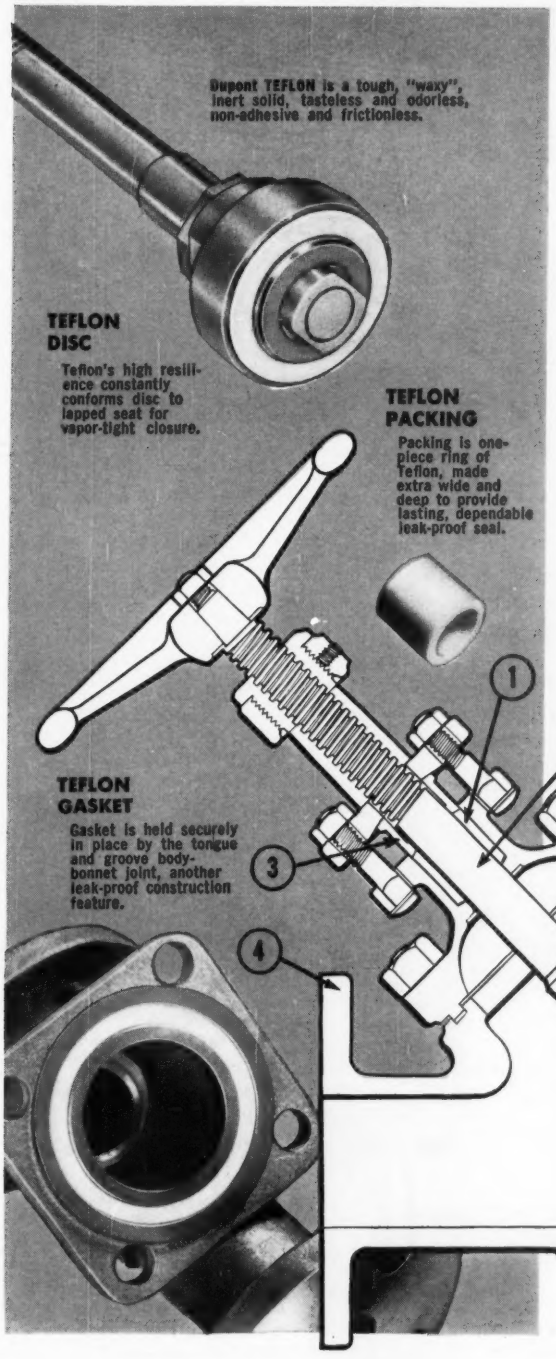
Jenkins designed for trouble-free performance... a

STAINLESS STEEL "Y"
to lower costs in a wider range of
CORROSIVE SERVICES

For food and chemcial plants, and similar services, Jenkins Fig. 1335 "Y" Globe offers many advanced features that will lower operating costs and keep your processing lines trouble-free. The disc, packing, and gasket are tough, resilient Teflon. Tasteless and odorless, it eliminates problems of contamination.

The "Y" pattern permits full flow, nearly equal to that of a gate valve, and also provides the vapor-tight closure and the ease of disc renewal of a globe valve.

Fig. 1335 offers extra value by any test . . . *initial cost, operating efficiency, low maintenance.* You can convert this extra value into *extra savings* on your toughest corrosive services. Call your Jenkins Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17.


Dupont TEFLON is a tough, "waxy", inert solid, tasteless and odorless, non-adhesive and frictionless.
TEFLON DISC
Teflon's high resilience constantly conforms disc to lapped seat for vapor-tight closure.
TEFLON PACKING
Packing is one-piece ring of Teflon, made extra wide and deep to provide lasting, dependable leak-proof seal.
TEFLON GASKET
Gasket is held securely in place by the tongue and groove body-bonnet joint, another leak-proof construction feature.
1
2
3
4

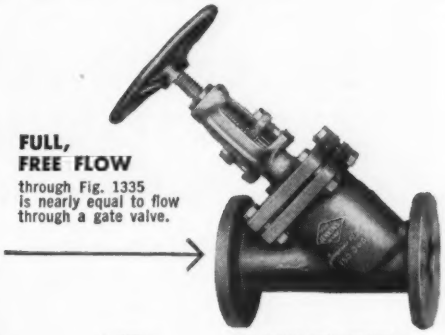


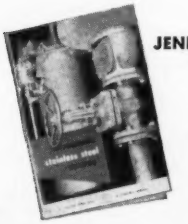
Fig. 1335 "Y" GLOBE
150 lbs. O.W.G. at 500°F
230 lbs. O.W.G. at 100°F
Sizes 1" to 4"

(1) **Packing Box**—Exceptionally deep and wide to hold optimum size packing.

(2) **Spindle**—Polished shank, long-operating threads, bevel shoulder for backseating.

(3) **Gland**—Two-piece for equalized pressure, tight seal.

(4) **Flanges**—Conform to M.S.S. Standard Practice S.P.42 Specifications.



JENKINS STAINLESS STEEL VALVE BOOKLET illustrates and describes wide range of Jenkins Globe, Gate, Check, and Y Valves, includes selection data, survey forms. Ask for Form 200-A.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros

HARSHAW

FLUORIDES

BORON TRIFLUORIDE
HYDROFLUORIC ACID
ANHYDROUS . . . AQUEOUS

Harshaw has been a pioneer in the development of fluorine bearing products with a background of over 40 years experience as a major producer of Hydrofluoric Acid.

If required, you are invited to draw on the knowledge and experience of our staff of technical specialists on fluorides. Broadly, we offer you the benefit of our accumulated experiences in engineering problems involving corrosion, safe handling and storage facilities.

WRITE *for Harshaw's 40-page Book on Hydrofluoric Acid Anhydrous. It provides helpful data for you if you now use HF or are considering its use.*

THE HARSHAW CHEMICAL CO.

1945 East 97th Street • Cleveland 6, Ohio

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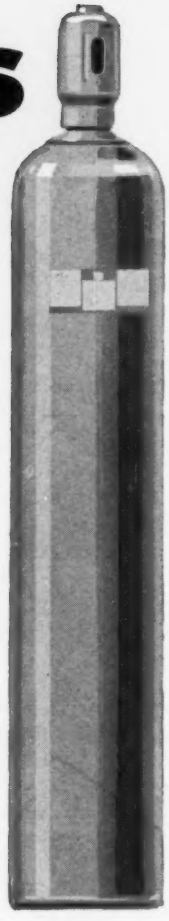

Here is an additional group of production-controlled, high-quality fluorides:

Ammonium Bifluoride
Ammonium Fluoborate
Antimony Trifluoride Sublimed
Barium Fluoride
Bismuth Fluoride
Boron Trifluoride
Boron Trifluoride Complexes
Chromium Fluoride
Copper Fluoborate
Fluoboric Acid
Fluorine Cells
Fluorinating Agents
Frosting Mixtures
Hydrofluoric Acid Anhydrous
Hydrofluoric Acid Aqueous
Hydrofluosilicic Acid
Lead Fluoborate
Metallic Fluoborates
Potassium Bifluoride
Potassium Chromium Fluoride
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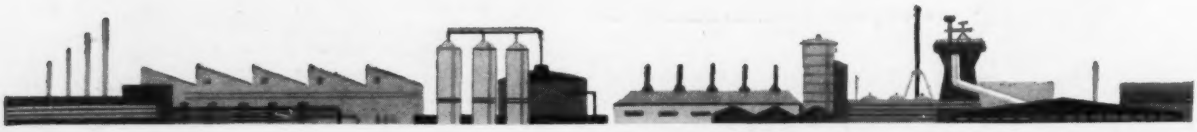
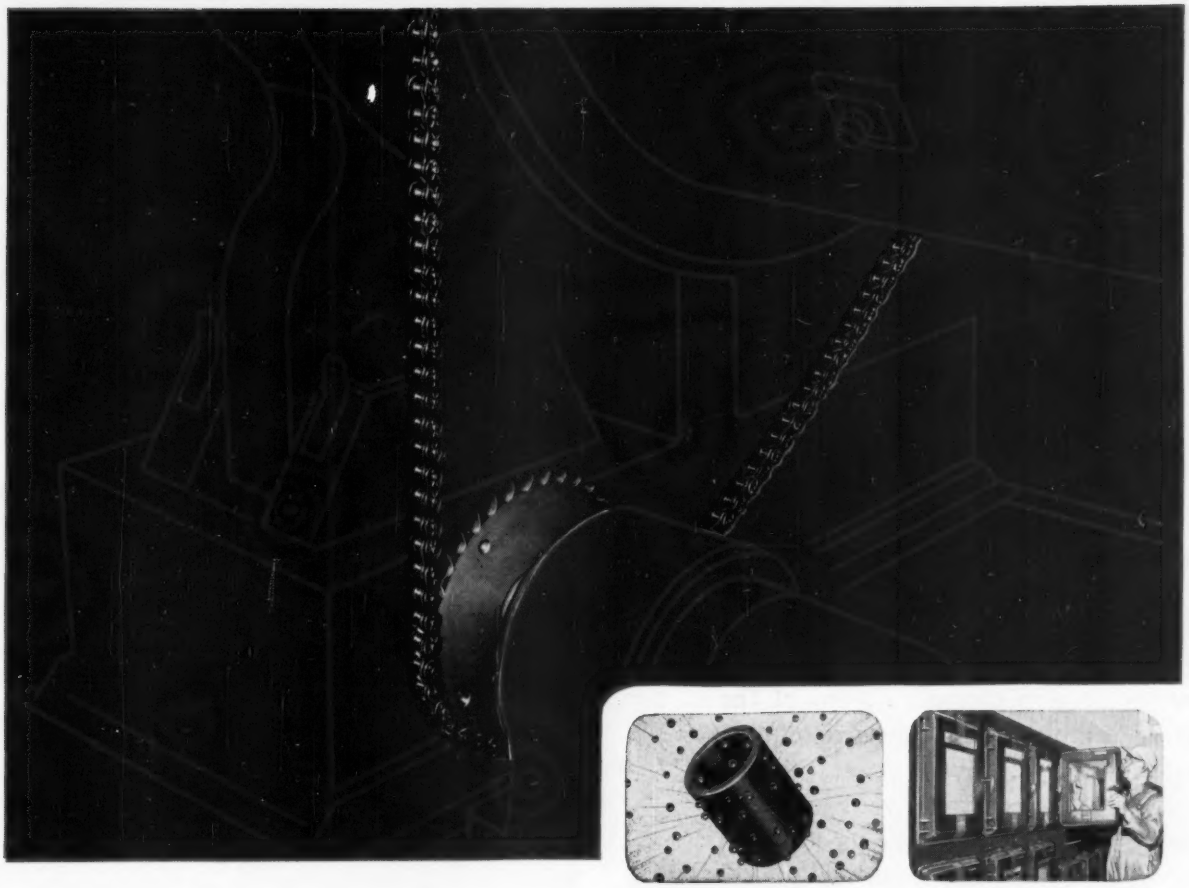
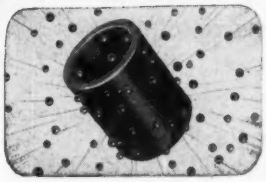
Silico Fluorides
Sodium Fluoborate
Tin Fluoborate
Zinc Fluoborate
Zinc Fluoride



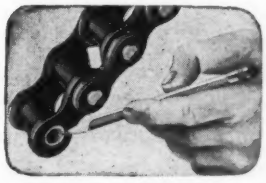
How these EXTRAS* make roller chain last longer



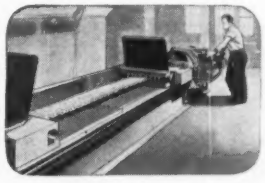


SHOT-PEENED ROLLERS have greater fatigue life, added ability to withstand impact.

CLOSER HEAT-TREAT CONTROL — coupled with rigid testing insures uniformity.



LOCK-TYPE BUSHINGS (applied on a range of sizes) end a cause of stiff chain.



PRE-STRESSING of multiple width chain provides uniform load distribution.

*And you pay no premium for these LINK-BELT extras

THERE'S more to roller chain than just the parts you see. *Much more!* It's the hidden extras—standard on Link-Belt Precision Steel Roller Chain —that add up to longer life and lower costs.

Check the four extras shown here. Then for your demanding drive and conveying jobs, choose from the complete line of Link-Belt roller chains and sprockets: Single or multiple widths, ¼" through 3" pitch. Double pitch, 1" through 3". There's full ordering and application information in 148-page Data Book 2457. Ask your Link-Belt office or distributor for a copy today.

LINK-BELT

ROLLER CHAIN & SPROCKETS

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

Practical service training at Honeywell's school . . .

makes your instrument men more valuable

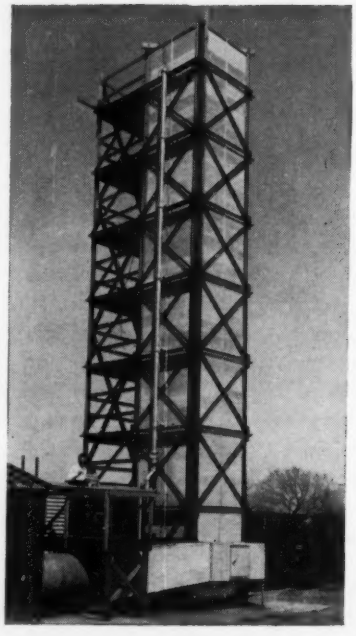
Your instrument maintenance men can get a real education in the most up-to-date methods for servicing instruments, at Honeywell's Training School. Any organization which uses Honeywell instruments can send maintenance personnel to this school. Tuition costs you nothing, for this school is maintained as a "plus-value" service to Honeywell customers.

Thousands of technicians have either started or augmented their instrument knowledge here. A variety of courses is available, to fit men for the particular kind of maintenance problems they may encounter in their specific jobs. The comprehensive course . . . one of the most complete and intensive offered anywhere . . . covers about thirteen weeks. Other courses cover five weeks and less, to offer condensed instruction of either a basic or "refresher" nature to men who can't be spared for extended periods.

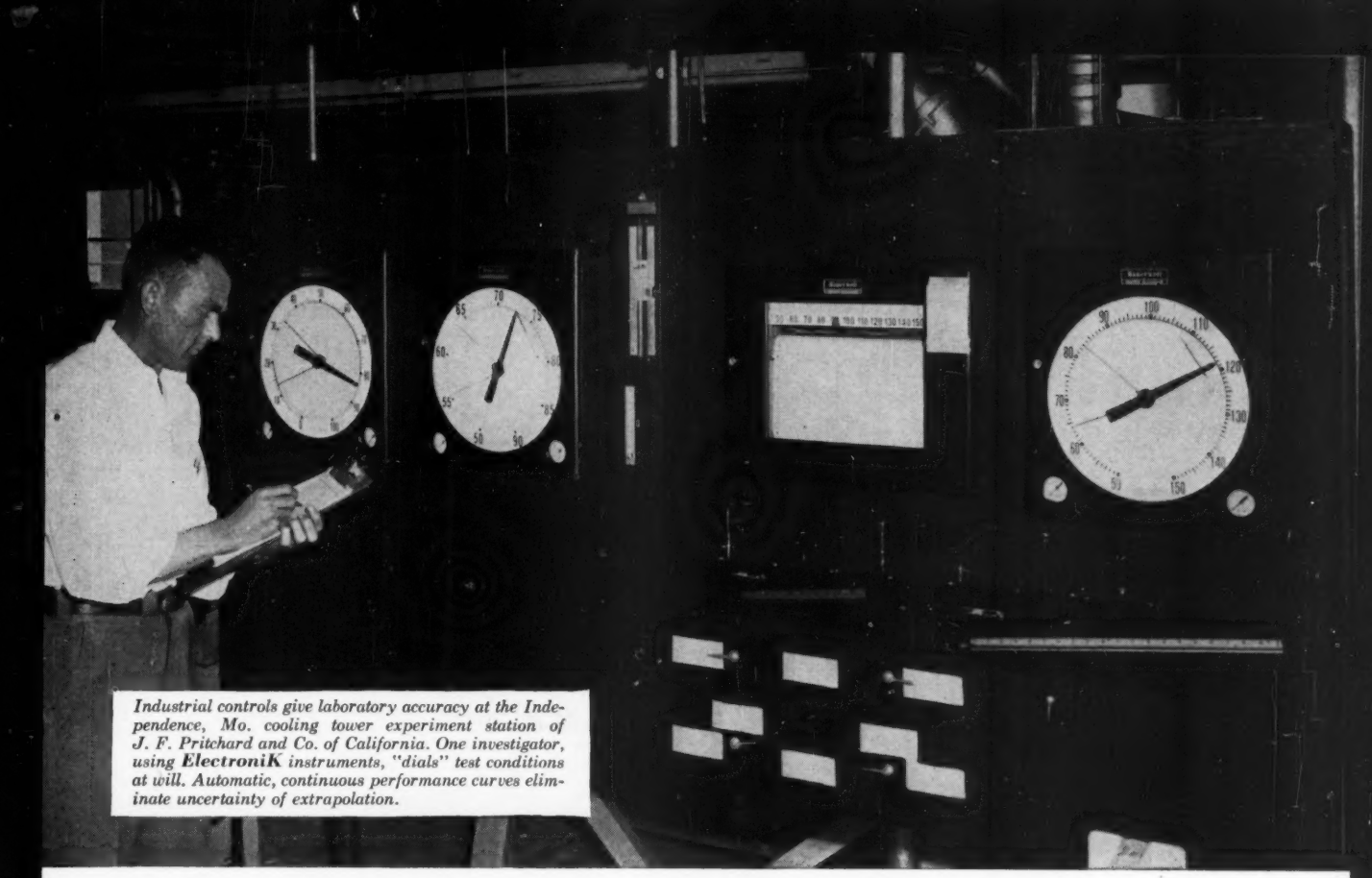
There's nothing academic about this school. The emphasis is placed on practical knowledge. Theory through lectures and textbook study is liberally supplemented by laboratory sessions and actual bench work on all types of instruments and related equipment.

One caution: classes have to be limited to assure thorough attention to all students, so make reservations in advance. Your local Honeywell office will be glad to make arrangements. Call today . . . it's as near as your phone.

Versatile *ElectroniK* instruments *increase speed,*



Experimental cooling tower stands 50 feet high. Tower can be used for any amount of deck filling from ground to maximum height to determine heat transfer efficiency and pressure drop.



Industrial controls give laboratory accuracy at the Independence, Mo. cooling tower experiment station of J. F. Pritchard and Co. of California. One investigator, using ***ElectroniK*** *instruments, "dials" test conditions at will. Automatic, continuous performance curves eliminate uncertainty of extrapolation.*

accuracy of cooling tower research

TEST SPEED more than doubled! Test data accurate within 2%! Test versatility expanded over a wide range! Test costs cut in half! *ElectroniK* instruments have revolutionized this cooling tower research.

From advanced, detailed studies of actual performance, engineers of J. F. Pritchard and Co., Kansas City, Mo. hope to devise formulas for *predicting* the performance of all types of deck filling, under all conditions of use. In these laboratory tests, all the major variables, including incoming air, are under automatic control. Investigators can "dial" test conditions at will, accelerating the research program considerably.

Two *ElectroniK* circular chart controllers maintain wet and dry bulb temperatures of incoming air within 0.2 F of test requirements. Another *ElectroniK* instrument controls water temperature with the same accuracy. An *ElectroniK* strip-chart recorder automatically and continuously compiles a detailed record of the six temperature variables that affect cooling tower performance. It also doubles as an "equilibrium" recorder to show when a test is completed.

Your nearby Honeywell sales engineer will be glad to discuss *ElectroniK* applications—research and processing—in your operation. Give him a call . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA: Write for reprint of article—3rd Quarter Issue, "INSTRUMENTATION."**

H HONEYWELL

MINNEAPOLIS **Honeywell**

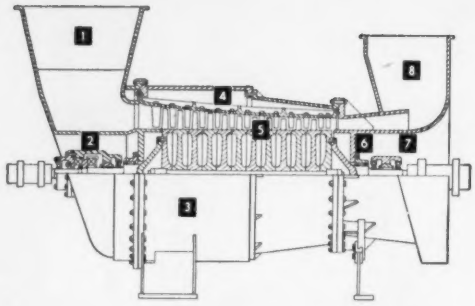
BROWN INSTRUMENTS

First in Controls

For large, constant volume flow and economical operation on any gas mixture...

CHOOSE CARRIER AXIAL FLOW COMPRESSORS

Multi-stage axial flow compressors have been manufactured at Carrier Corporation since 1948. Many hundreds of these units have been produced and have operated satisfactorily for a cumulative total in excess of 30 million machine hours.



Cutaway view of the Carrier Axial Flow Compressor

1. Suction casing
2. Thrust bearing
3. Outer casing
4. Stator
5. Rotor
6. Seal
7. Journal bearings
8. Discharge casing

Carrier Axial Flow Compressors fill industry's need for a machine of large volume flow capable of operating on any gas mixture. Frame sizes are rated up to a quarter-million cubic feet per minute when operating on air.

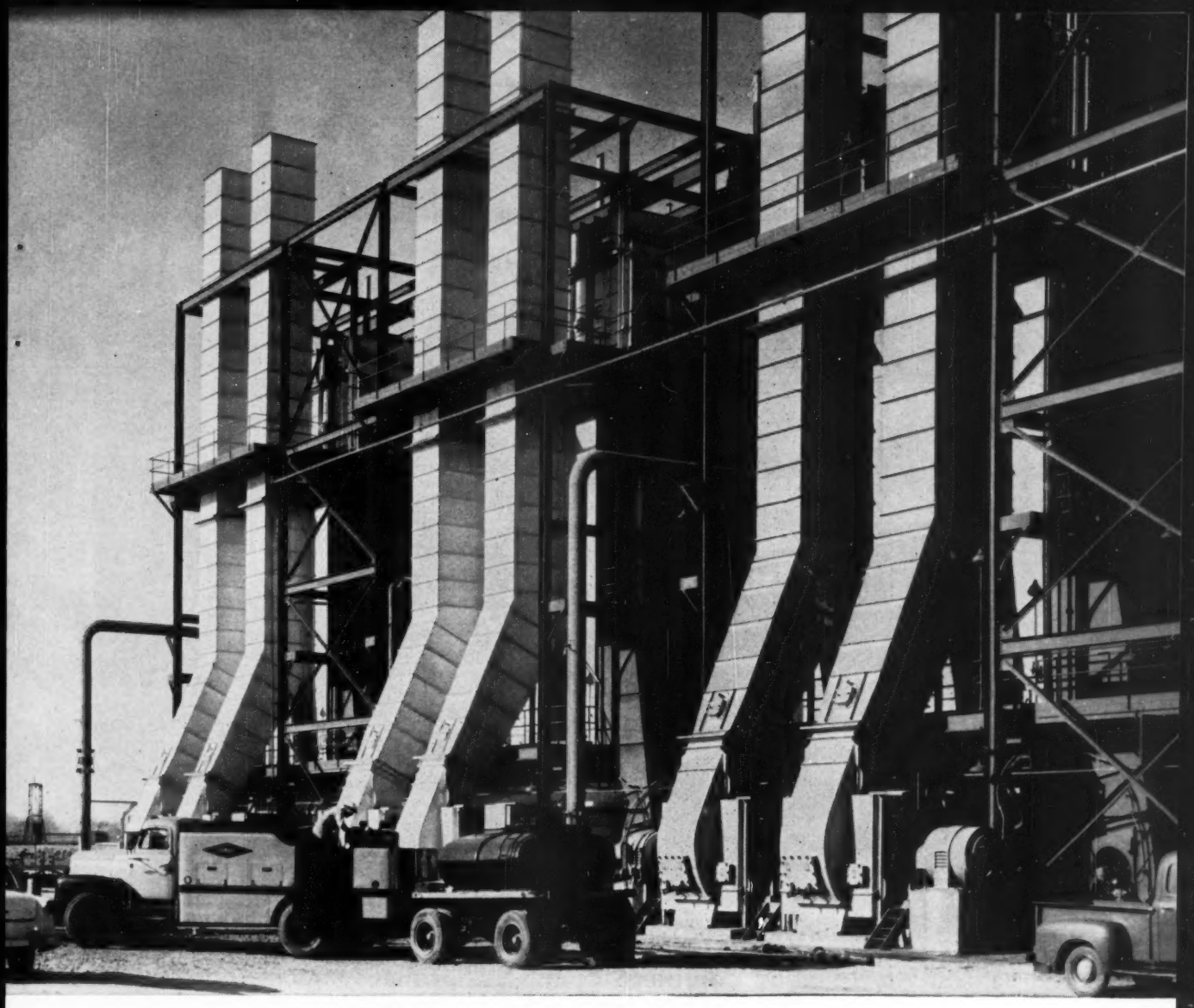
Uses for this versatile machine range from applications in the petroleum refining, chemical processing and steel industry to wind tunnels, sewage processing and mine ventilation.

Carrier has built more industrial multi-stage compressors than any other company in the world. This unequalled experience assures a machine of high efficiency, which is reflected in lower operating costs.

If you would like a copy of our folder on axial flow compressors, call your nearest Carrier office. Or write direct to Carrier Corporation, Syracuse, New York.

Carrier

compressors for industry
refrigerating equipment



BOILER TUBE FAILURES ELIMINATED

Regular program of DOWELL chemical cleaning for six boilers ended tube failures due to scale

The tubes of a 500,000 pph boiler in a chemical plant contained an extremely hard high-silicate scale up to 1/16-inch thick. Mechanical cleaning was unsatisfactory, because it required a long shutdown and still left hard scale in the tubes.

Dowell engineers formulated a special solvent and quickly removed the scale from the boiler. The operator now has all six of the 500,000 pph boilers on a regular schedule of Dowell chemical cleaning. Since the beginning of this program, the boilers have been cleaned several times and there have been no tube failures caused by scale deposits.

Chemical cleaning is designed to add years of life to your equipment by helping to protect it from over-heating, galvanic attack, and pitting-type corrosion. Downtime is held to a minimum, because solvents are introduced through regular connections . . . extensive dismantling and scaffolding are not needed.

Dowell Service brings you over a decade of experience in the chemical cleaning of many kinds of equipment, including more than 10,000 high- and low-pressure boilers. Contact the nearest Dowell office for more information. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept. I-33.

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

when Efficiency is important

in handling dry materials in bulk

. . . call on Fuller

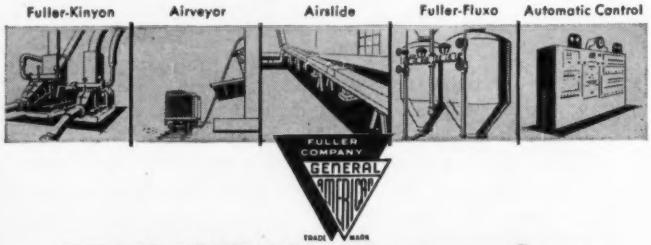
. . . . pioneers in harnessing AIR

In *every well-run business,*

the degree of efficiency dictates profit or loss.

Your degree of materials handling efficiency merits careful watching because, as analysis of your complete operation probably would show, the flow of bulk materials from Receiving to Storage to Process, or Shipping governs your entire manufacturing process in dozens of different ways.

For the most efficient utilization of your manpower and your equipment, call on Fuller for a realistic appraisal of your needs. Be sure to ask for Fuller's Bulletin G-2, "How to Pull Dollars Out of Thin Air."

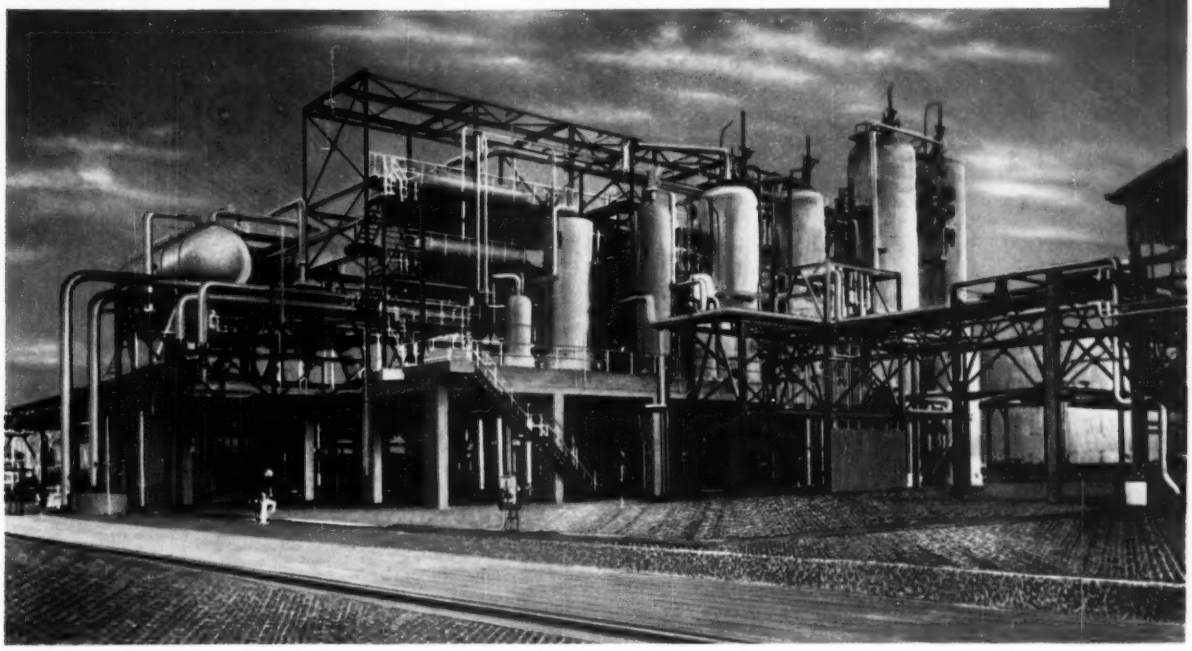


FULLER COMPANY, Catasauqua, Penna.
GENERAL AMERICAN TRANSPORTATION CORPORATION SUBSIDIARY
Chicago · San Francisco · Los Angeles · Seattle · Birmingham

Fuller
. . . . pioneers in harnessing AIR

1841
G-113

OIL FOR EUROPE'S INDUSTRY



The new deasphalting unit at Shell's Refinery at Pernis, near Rotterdam, The Netherlands, has a maximum design charge capacity of 12,000 barrels of reduced crude per day.

As part of an expansion program at their Refinery at Pernis, N.V. de Bataafsche Petroleum Maatschappij, a subsidiary of Royal Dutch Shell, employed E. B. Badger & Sons Limited, in collaboration with Stone & Webster Engineering Corporation, to design and engineer a new propane deasphalting and decarbonizing unit.

The unit produces lubricating oil base stock and catalytic cracking unit feed stock.

Important fuel savings are made by employing multiple effect evaporation for the first time in this type of unit to remove propane from the oil stream.

Design work was begun in September, 1952, and the unit—largest of its type outside of the United States—went on stream in the fall of 1954. Actual construction was by local contractors.

Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS LIMITED (LONDON)

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

Photo courtesy Lincoln-Mercury Division, Los Angeles

How demineralized water keeps Lincoln-Mercury enamel blister-free

Auto bodies get rinsed with water after phosphatizing and after the prime paint coat. If the water contains too much salt, it leaves deposits that can cause pinhead blisters in the finished paint job. So when paint chemists at Lincoln-Mercury's Los Angeles plant checked and found that the waterwork's newest well was "salty," they took action.

They investigated drilling a new well and laying pipe to a better well. But these methods don't provide a permanent solution because the character of a well water often changes (with the level of the water table, etc.).

That's why Lincoln-Mercury decided to remove *all* mineral salts from their rinse water. To do this at low cost, they chose a Permutit Demineralizer (2 cation exchangers, 2 anion exchangers, 2 decarbonation tanks).

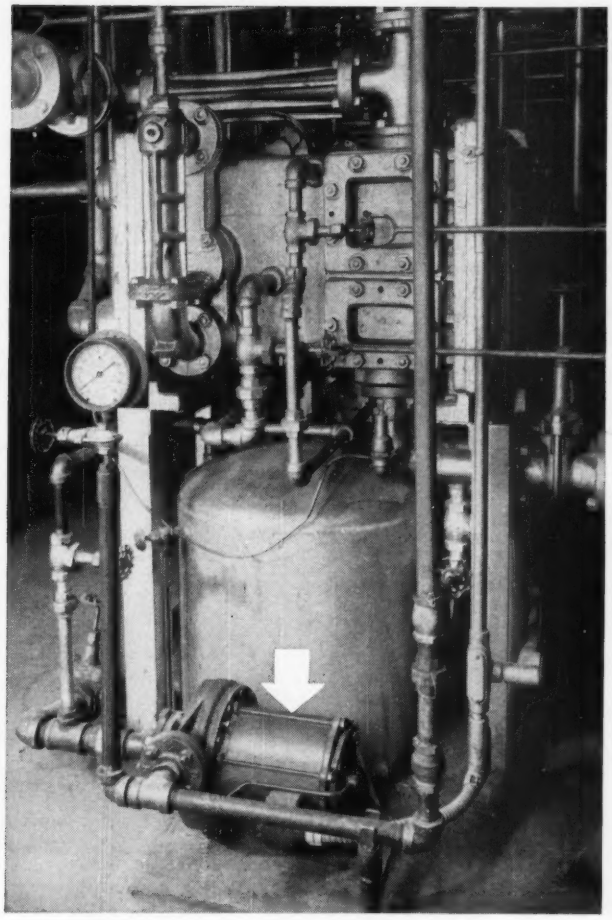
This Permutit Demineralizer keeps water quality uniformly high despite changes in the water supply. It actually delivers water as mineral-free as commercially distilled water. The results: beautiful finishes that stay blister-free.

Unvarying high-grade water may solve your quality-control problem. Let us help you get it at low cost. Write: The Permutit Company, Dept. CE-9, 330 West 42nd St., New York 36, New York.

PERMUTIT®
ION EXCHANGE
for Water Conditioning • Chemical Processing

Chempump

prevents costly leakage at Bakelite Company



2 hp *Chempump* installed on condenser unit at Bound Brook, N. J., plant of Bakelite Company. This is a vacuum system operating at 28 inches of mercury. Pump discharges at 9 psig. Based on outstanding performance of *Chempump* under extreme vacuum, company is purchasing additional units.

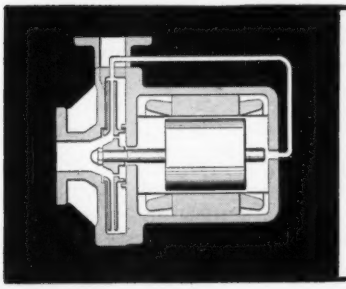
PUMPING condensate from a condenser unit under vacuum posed a critical problem at Bakelite Company. If the pump lost its prime, the condensate would fill up the tank and back up into the system, causing considerable lost time and damage. Any air leakage would destroy the vacuum and render the system inoperative.

Previous pumping equipment required frequent maintenance due to stuffing box leakage. With installation of a seal-less *Chempump,* however, all leakage and vacuum problems were eliminated. Virtually maintenance-free, *Chempump* has shown outstanding performance.

Another tough leakage problem solved by *Chempump.* With this seal-less combined motor-pump unit, normally hard-to-handle fluids can't leak or become contaminated. Periodic inspection to indicate necessity of simple bearing change is the only maintenance required.

Your process can benefit through *Chempump,* too. For details, send for new 16-page Bulletin 1010. Chempump Corp., 1300 E. Mermaid Lane, Phila. 18, Pa.

Engineering representatives in over 30 principal cities in the United States and Canada.



Chempump combines pump and motor in a single hermetic unit. Pumped fluid enters rotor chamber; no shaft sealing device required.

Approved by Underwriters' Laboratories. Available in wide choice of materials . . . from ⅛ to 7½ hp. Capacities to 250 gpm. Heads to 195 feet.

Chempump can't leak!

***Chempump* —first in the field...process proved**

Chempump Corp., 1300 E. Mermaid Lane, Phila. 18, Pa.

Please send me details on *Chempump* for:

_____
(application)

*Capacity*_____ *Total dynamic head*_____

*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City*_____ *Zone*_____ *State*_____

This chunky welded vessel was tested to 3885 psi

The welded vessel shown here, suggestive of a squat mechanical man, gives you an idea of the unusual jobs handled by our Bethlehem Weldment Shop.

A major manufacturer of pumps will utilize this complex vessel as the heating tank of a pump-testing unit. Designed by Catalytic Construction Company, of Philadelphia, the vessel with its 6-ft-high body tips the scales at 3726 lbs. Its shell is made of 2 1/16-in.-thick rolled plates of ASTM A-212 Grade B Firebox steel. The heads are 1 13/16-in. spun plates. The vessel withstood a hydrostatic test of 3885 psi, well in excess of the maximum allowable working pressure of 2590 psi. Maximum working temperature is 650 deg. F.

Construction was by both submerged-arc and hand welding, and a tricky job it was, with the many fittings you see here. The entire vessel was stress-relieved and all welds were radiographed. Joint efficiency is 100 pct for the heads, and 95 pct for the shell, conforming to the ASME code.

We suggest that you entrust to Bethlehem your requirements for all types of vessels, small and large, simple and complex. Our fabricating works at Bethlehem, Pa., and Beaumont, Texas, are fully equipped and experienced to produce welded vessels of exceptional quality. Please contact the Bethlehem sales office nearest you for any additional information.

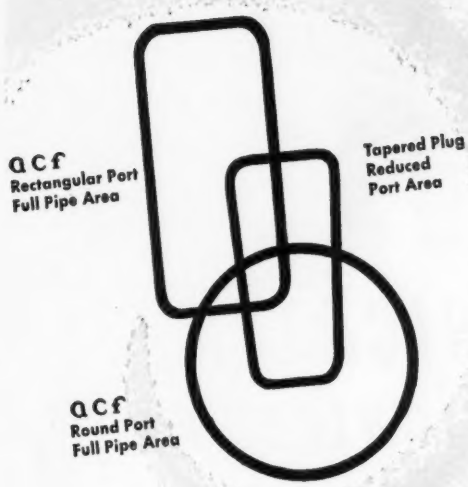
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corp. Export Distributor: Bethlehem Steel Export Corp.

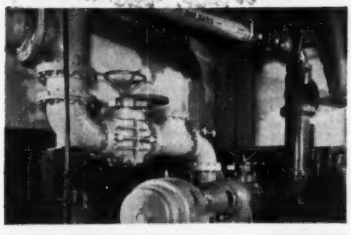
BETHLEHEM STEEL

BETHLEHEM STEEL

BEFORE YOU BUY ANOTHER PLUG VALVE...



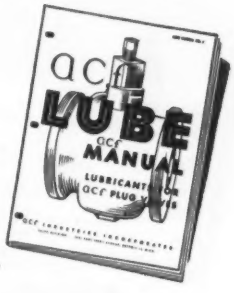
COMPARE THE PORT OPENINGS!



acf Plug Valves are backed up by Proof-of-Performance in every Processing Industry!

Turbulence! Loss of head pressure! These can present real problems when handling slurries and other viscous liquids! And because they are ordinarily the result of valves with "funnel action"...it pays you to make sure that the port opening has the same area as the pipe itself!

Pipe-matching port openings! This is only one of the reasons why more processing engineers than ever before are swinging over to acf Round Port Valves and Rectangular Port Valves. Other features, such as split-second, quarter-turn shut off...specially designed TEFLON* GASKET to prevent head leakage...all add up to lower maintenance costs and fewer work stoppages.



WRITE TODAY for descriptive Catalog E-8, acf Industries, Incorporated, Valve Division, 1501 E. Ferry Avenue, Detroit 11, Michigan

GET YOUR COPY of the acf Lube Manual, a complete description of lubricants and service recommendations. Ask for Manual No. 3.

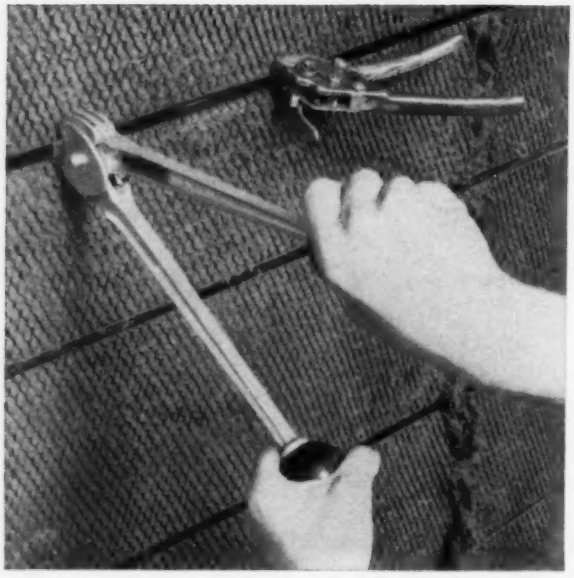
*DuPont Tradename

acf CYLINDRICAL FULL PIPE AREA **PLUG VALVES**

EAGLE-PICHER

BLANKET INSULATION

FACTORY FABRICATED to rigid specifications



FACTORY FABRICATION is your assurance Eagle-Picher Blankets are completely free of large "voids" usually found in field made blankets where insulation is simply packed in place. Because they're uniform these blankets can be tightly butted together to eliminate cracks and loose joints.

FACTORY FABRICATED to rigid specifications is your assurance that copper bearing steel laths, bound by uniformly spaced soft-drawn galvanized tie wires, keep the blankets firm but flexible. They can be quickly applied to flat or slightly curved surfaces on any large heated equipment—or cut to fit irregular areas.

FACTORY FABRICATED to rigid specifications means that *every* blanket is made up of many layers of Eagle-Picher mineral wool uniformly dispersed over the entire area of each blanket. The outstanding chemical and physical characteristics of Eagle-Picher mineral wool provide maximum thermal efficiency at temperatures as high as 1200 F.

WRITE FOR FREE SAMPLE TODAY!

Prove to yourself that Eagle-Picher Blankets are factory fabricated to meet your own exacting standards!

Since 1843

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY

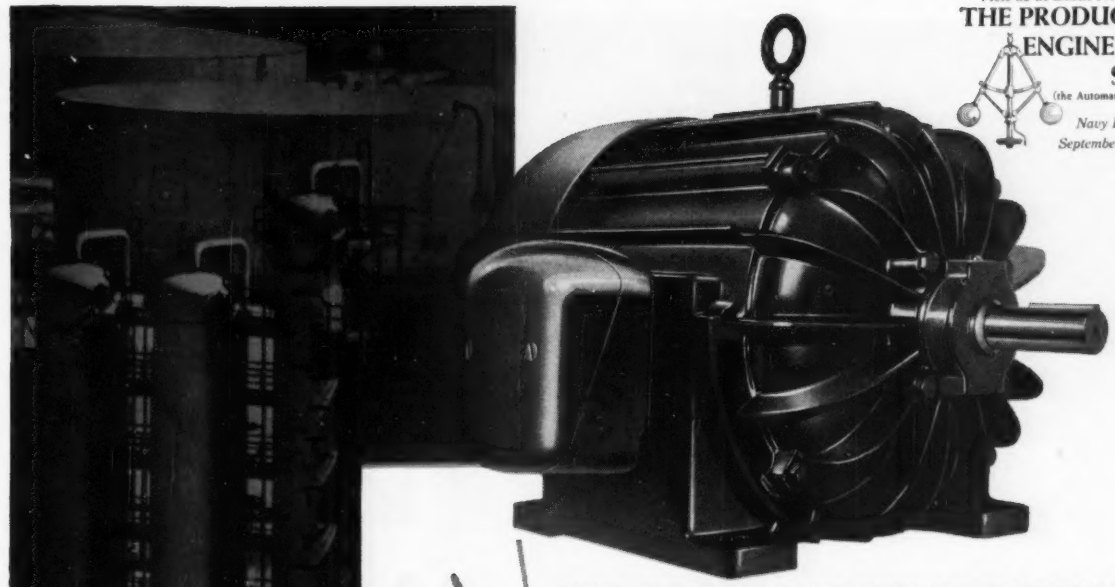
Producing a complete line of industrial insulations

Cincinnati 1, Ohio

(Member of Industrial Mineral Fiber Institute)

(Conforms to Commercial Standard CS 117 and Federal Specification HH-I-565)

Visit us at Booth No. 429 at the
THE PRODUCTION ENGINEERING SHOW
(the Automation Exposition)
Navy Pier, Chicago
September 6-16, 1955



FOR CHEMICAL PLANT APPLICATIONS

New DIEHL TYPE "DIF"

totally-enclosed, fan-cooled MOTORS

Designed specifically for the Chemical Industry to specifications outlined by chemical plant engineers. Corrosion and moisture resistant features throughout provide long life, minimized maintenance and top efficiency. On dryers, agitators, ball mills, mixers, vibrators, pumps, blowers, compressors and other processing machinery, these rugged motors give uninterrupted dependable performance under the severest operating conditions. For indoor or outdoor service, specify the Type "DIF" Motor for maximum protection.

Here's your assurance of protection against chemical liquids, vapors, gases, fumes, powders and dusts:

- Corrosion and moisture resistant poly-vinyl finish
- Heavy cast-iron totally enclosed construction
- Large cast-iron corrosive resistant terminal box
- Special bronze alloy ventilating fan
- Poly-vinyl insulated stator leads with non-hygroscopic, non-aging, chemical resistant characteristics
- Multiple-insulated stator windings
- Double-protected rotor components
- Oversize pre-lubricated ball bearings

Background photograph courtesy of Standard Oil Co. (N. J.)

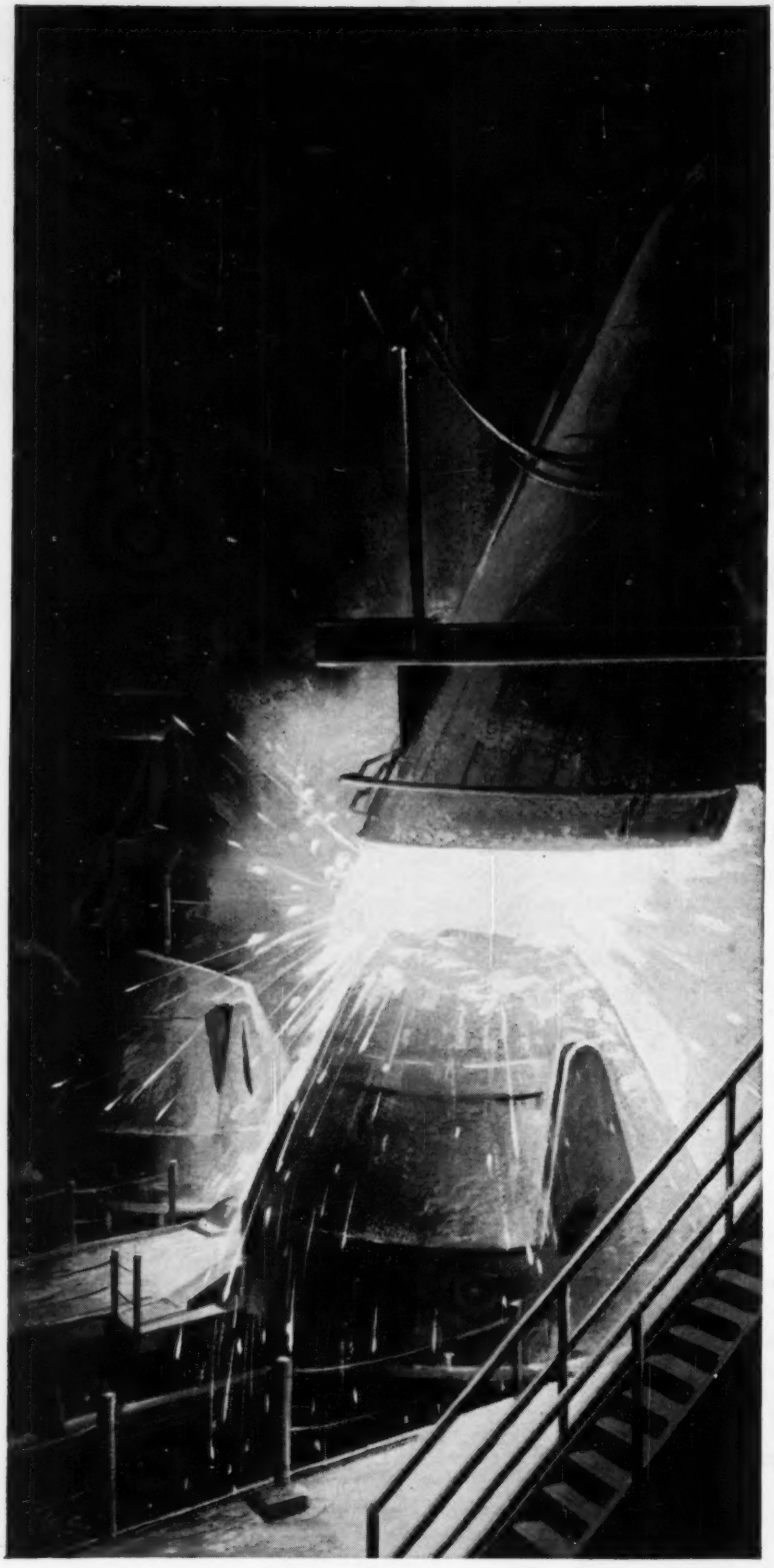
DIEHL MANUFACTURING COMPANY
Electrical Division of THE SINGER MANUFACTURING COMPANY
Finderne Plant, SOMERVILLE, N. J.

Please send me the following bulletins:

☐ Type "DIF" Chemical Motor Bulletin No. CE-3379
☐ Consolidated Motor Catalog and Price List No. CE-3310

Name_____
Company_____
Street_____
City_____ State_____

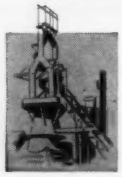
OTHER INTEGRAL AND FRACTIONAL HORSEPOWER MOTORS ARE AVAILABLE IN A WIDE RANGE OF TYPES AND SIZES



McLouth
HIGH QUALITY
Steel

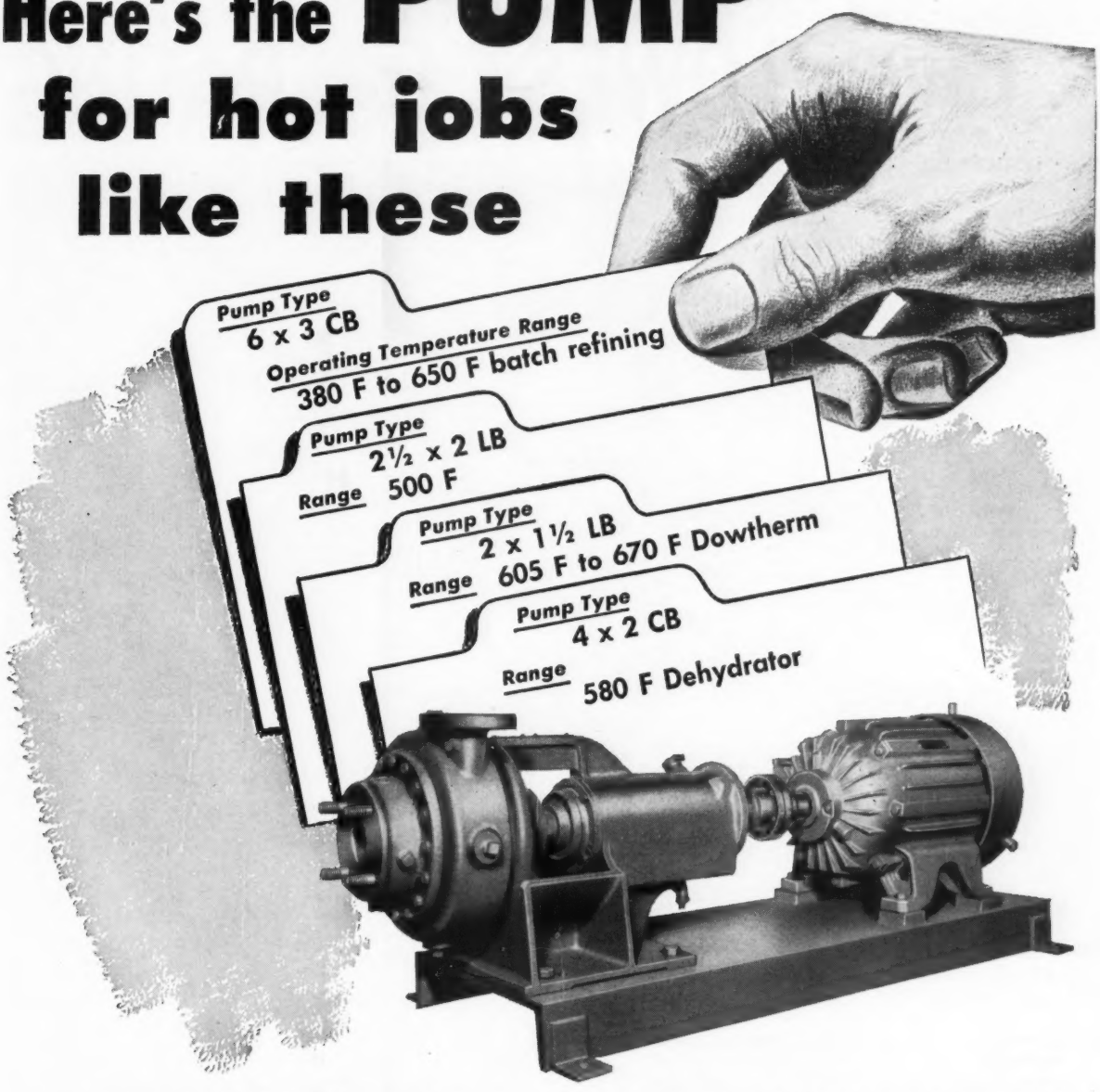
We are now operating the first Oxygen Steel Process in the United States. This dramatic new method of refining is producing high quality steel with a low nitrogen content.

The advantages of the Oxygen Steel Process are another reason why McLouth high quality sheet and strip steels will serve you better in the product you make today and the product you plan for tomorrow.



McLOUTH STEEL CORPORATION
Detroit, Michigan
MANUFACTURERS OF STAINLESS AND CARBON STEELS

Here's the PUMP for hot jobs like these



ALLIS-CHALMERS oil-lubricated pumps have excellent service records on many types of high temperature applications like those shown here. This pump is of simple design, yet has all the features required for low cost, low maintenance operation at high temperatures.

Check the design and construction features that make this possible:

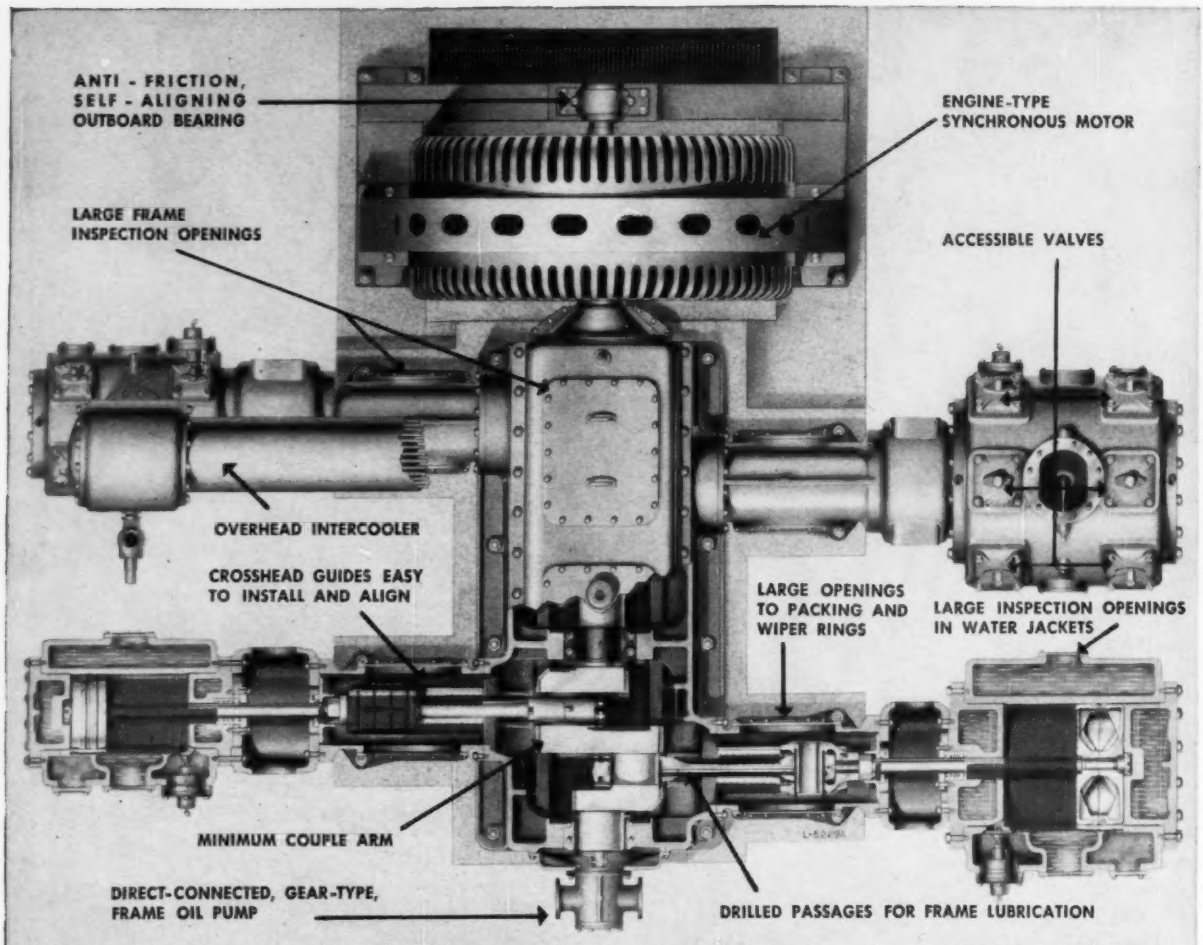
- Built in a wide range of ratings . . . capacities to 3500 gpm, heads to 400 feet.
- Available in wide choice of materials, including iron, bronze, aluminum bronze, stainless steel, high nickel alloys and others.
- Jacketed casing and stuffing box and water-cooled bearings optional.
- Adaptable for packing, mechanical seal or both.
- Simple, accessible design makes maintenance easy.

Allis-Chalmers can supply you with a complete pumping unit — pump, motor and control — all of coordinated design and manufacture and delivered assembled and ready to install. Get complete information from your Allis-Chalmers District Office, or write Allis-Chalmers, Milwaukee 1, Wisconsin, and ask for Bulletin 52B7638.

A-4656

ALLIS-CHALMERS

Worthington Balanced Gives LOWEST OPERATING


ANTI - FRICTION, SELF - ALIGNING OUTBOARD BEARING
ENGINE-TYPE SYNCHRONOUS MOTOR
LARGE FRAME INSPECTION OPENINGS
ACCESSIBLE VALVES
OVERHEAD INTERCOOLER
CROSSHEAD GUIDES EASY TO INSTALL AND ALIGN
LARGE OPENINGS TO PACKING AND WIPER RINGS
LARGE INSPECTION OPENINGS IN WATER JACKETS
MINIMUM COUPLE ARM
DIRECT-CONNECTED, GEAR-TYPE, FRAME OIL PUMP
DRILLED PASSAGES FOR FRAME LUBRICATION

CUTAWAY OF FOUR CYLINDER BALANCED OPPOSED COMPRESSOR. Just one of the many multi-service cylinder arrangements available. Option of drivers gives full freedom in choice of power or fuel for maximum economy and convenience. Available drivers include: direct-connected engine-type synchronous motor *(shown);* steam turbine through reduction gear; special induction motor; or direct-coupled internal combustion engine. Red areas show lubrication coverage.

"Easier to inspect and maintain than any similar compressor." That's what engineers say about the Worthington Balanced Opposed Compressor.

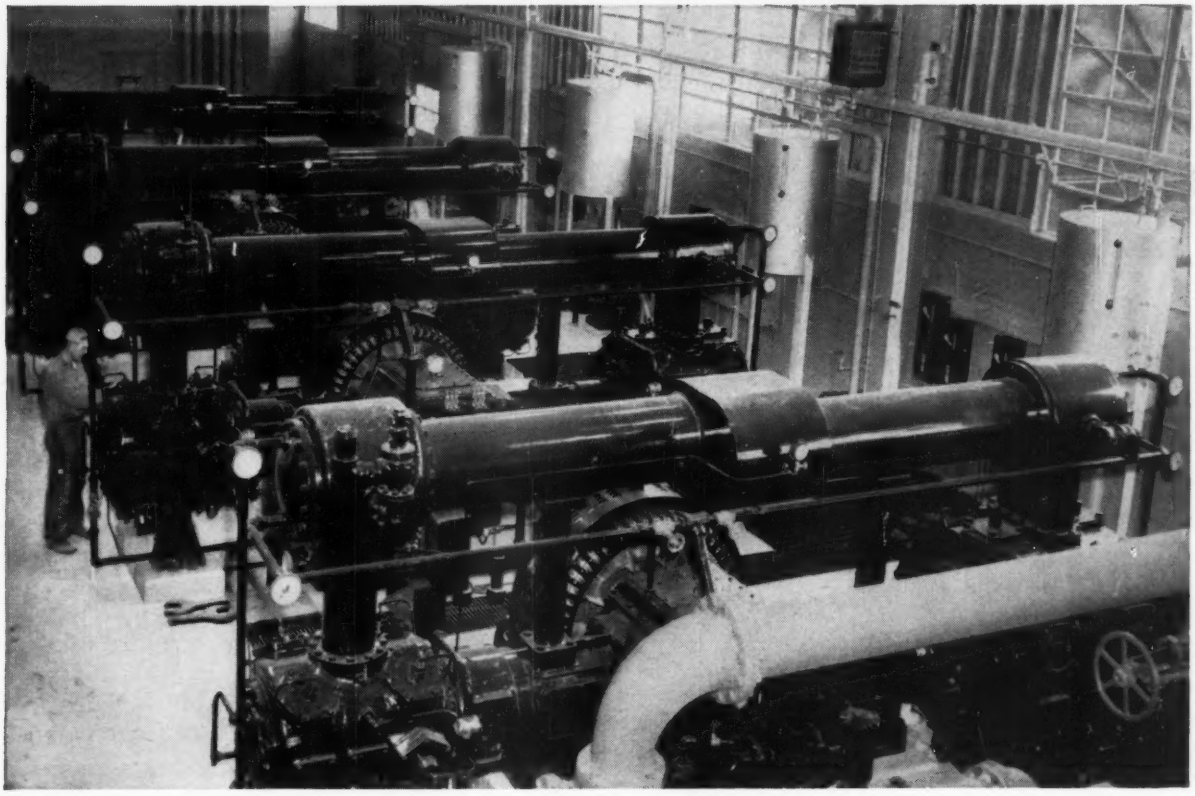
LARGE ACCESS OPENINGS are provided for inspection and maintenance of piston rod packing, oil wiper rings, water jacket, main bearings, crossheads, and crosshead guides. All valves are accessible and easily replaced. This easy accessibility of working parts facilitates *preventive* maintenance, reduces downtime for *corrective* maintenance.

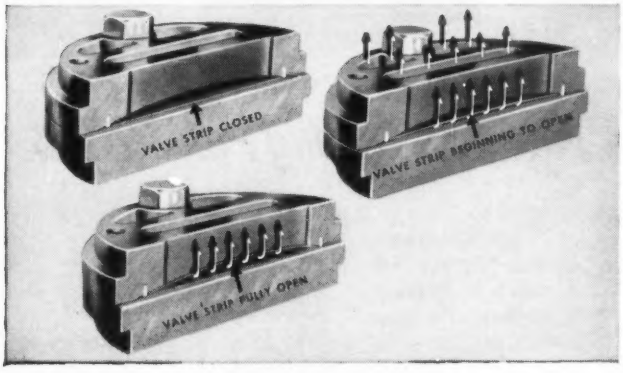
REDUCED INSTALLATION COSTS because foundations can be smaller. Inertia forces developed in one cylinder are bucked and largely cancelled out by similar and opposite forces developed in the opposing cylinder. Only a relatively small turning force, or couple is transmitted to the foundation. As a result, foundations are smaller for the balanced opposed than for equally rated compressors of other designs.

MAXIMUM STRENGTH, MAXIMUM STABILITY, result from the rugged one-piece-cast main frame and most stable construction of any similar compressor. Main bearing supports are integral with frame and reinforced with heavy steel tie bars over each bearing. Keyways in frame seat each tie bar and lock it in place, permanently preserving alignment.

AVAILABLE SIZES AND TYPES range from 300 to 10,000-hp with pressures from vacuum to 35,000 psig. A few applications include (figures indicate orders of magnitude only): *dry vacuum pumps* operating at very low pressures, *standard shop air compressors* (125 psig), *refrigeration gas compressors* (250 psig), and *multi-stage gas compressors* for use in service such as ammonia synthesis, methanol and hydrogenation plants (3500 to 35,000 psig). For more information, write for Bulletin L-679-B1 on company letterhead. Worthington Corporation, Section K.5.2, Harrison, New Jersey.

Opposed Compressor Design and MAINTENANCE COSTS





COMPRESSED AIR for Ford plant in Mahwah, New Jersey, is supplied by this array of four 450-hp, 100 psig Worthington Balanced Opposed Compressors.

HIGH-SPEED, LOW INERTIA Worthington Feather® Valve contributes to quiet operation and easy maintenance of Worthington Balanced Opposed Compressor. Thin, flexible strips of stainless ribbon steel form active elements. Curved guards hold strips in position over rectangular openings. Strips lift and flex uniformly against guards. Absence of impact results in quiet operation, longest valve life and low maintenance costs.

WORTHINGTON

K.5.2

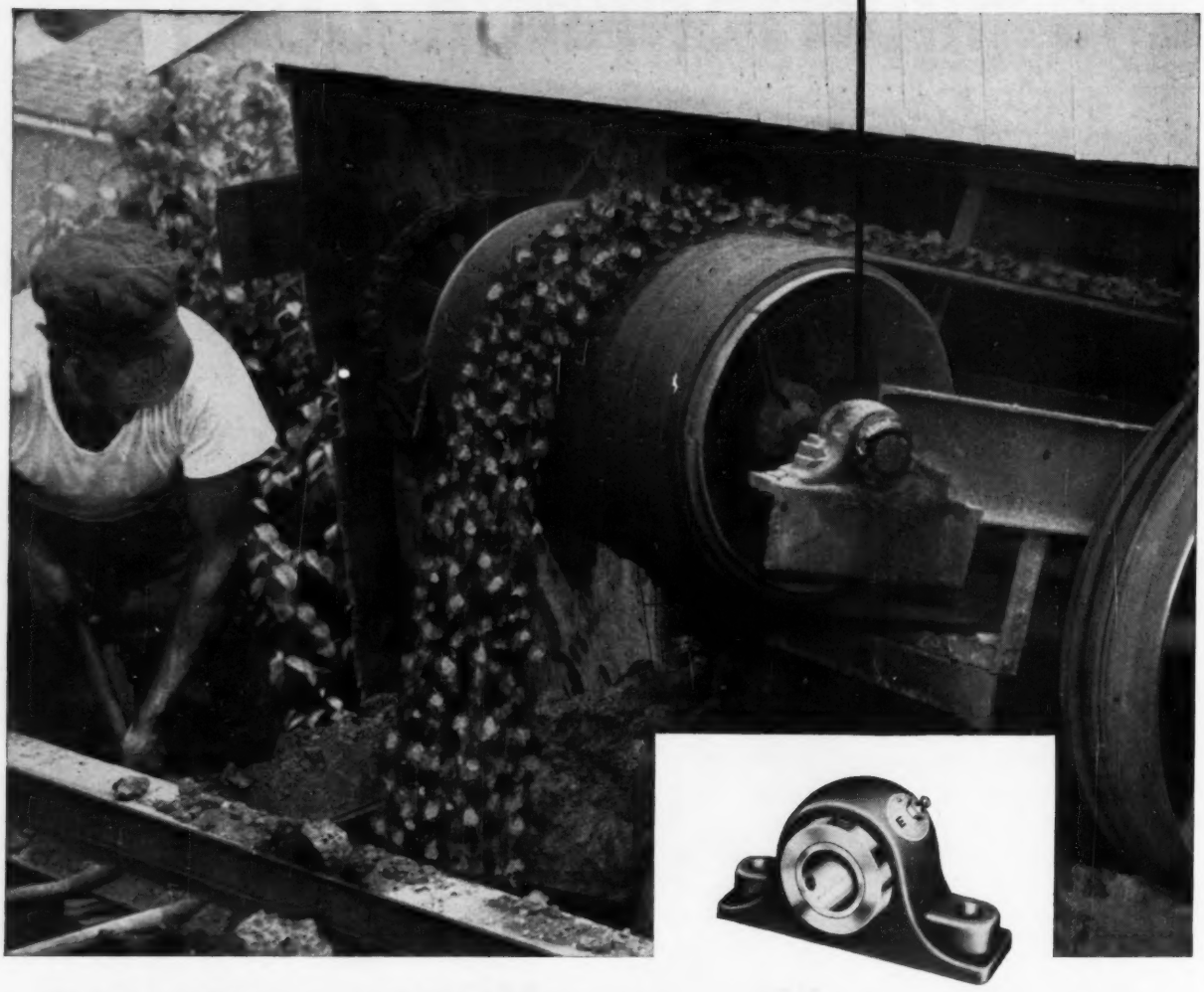
Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors

COMPLETELY ASSEMBLED
FACTORY ADJUSTED
PRE-LUBRICATED

SEALED

—ready to mount on the shaft!



DODGE-TIMKEN *America's Quality Pillow Block*

Extra measures are taken to build superior quality into Dodge-Timken Bearings; and extra precautions are taken to keep that quality *intact*—from the factory to distributor to you to your machines.

These bearings are sealed in manufacture—an integral part of Dodge-Timken design. Their inbuilt precision is protected *both on and off the shaft.* That is one reason why they easily deliver a minimum of 30,000 hours of service. Want evidence? Look around you. No other pillow block is so widely used on the nation's tough jobs. Dodge-Timken dependability has been proved in *millions* of installations.

There are 5 types of Dodge-Timken Pillow Blocks for all types of service, in shaft sizes from 1 3/16" to 10". Also Dodge-Timken Hanger Bearings, Flange Bearings, Take-ups.

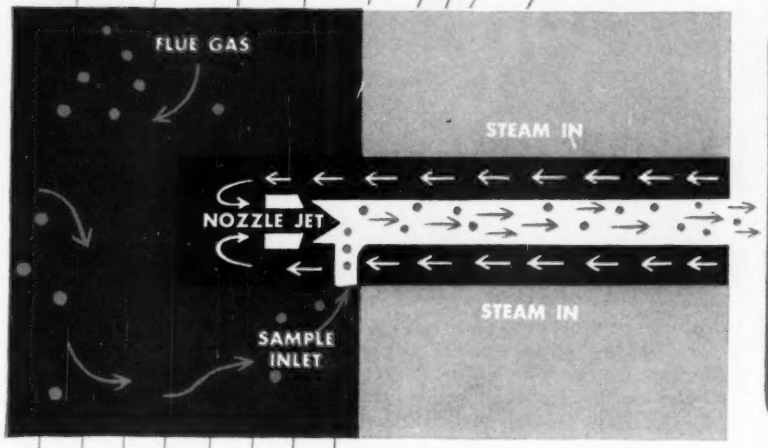
DODGE MANUFACTURING CORPORATION, 200 Union St., Mishawaka, Indiana

DODGE

of Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone directory, or write us.

NEW DIMENSIONS



in Gas Sampling

NEW SAMPLING SYSTEM OPERATES ON STEAM!

The new Hays Gaspirator* System is designed especially for difficult gas sampling problems involving high dust loading and high temperatures. It now permits accurate O_2 measurement, previously impossible in many applications.

This gas sampling system uses steam to obtain a continuous, clean sample. Suction which is created by the jet nozzle draws the sample in, where it is mixed with the steam. The steam is then condensed. Condensate and entrained solids drop down, and the sample is forced through the analyzer under pressure.

Hays, in the field of gas analysis for more than fifty years, developed the Gaspirator for use with their Magno-Therm Analyzer.

This analyzer, which operates on the paramagnetic principle, has for years been accepted as the leader in the field of O_2 measurement. Hundreds of companies are using the Magno-Therm and Hays electronic recorders very successfully in boiler plants and on process furnaces as a combustion guide, in regeneration of catalysts in refineries and in many other process applications.

For further details write for Bulletin 55-829-56.

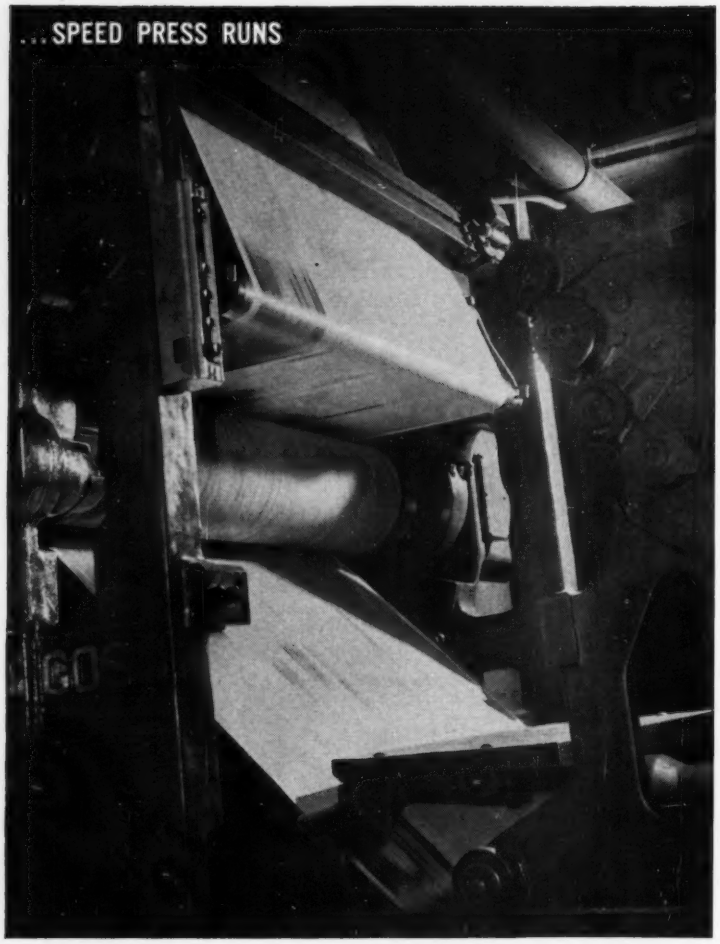
*Patents pending.

THE **hays** CORPORATION

MICHIGAN CITY 9, INDIANA

Automatic Combustion Control • Varriflow Meters and Varitrol • Electronic Oxygen Recorders • CO_2 Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

HOW HERCULES HELPS...



QUICK DRYING INKS are as important as press speeds in getting large quantity printing jobs off on schedule. For every type of printing requirement—whether it be high speed or specialized—there's a Hercules resin or film-former to assist the ink maker in achieving the best possible formulation for the purpose.

RECENT RESEARCH shows that nonionic surface-active agents make earth soak up water more readily, hold on to it longer. Hercules nonionics, now being used for this purpose, may provide a key to better growth of lawns, flowers, gardens, and farm crops.

AN INVITING POOL takes more than water. As part of the regular maintenance program the sides of the pool must be painted with a protective coating that resists continual submergence. For such uses, and wherever coatings must withstand the challenge of water, acid or alkali, paints based on Hercules Parlon® (chlorinated rubber) give longer service at lower long-term cost.

HERCULES

CHEMICAL MATERIALS FOR INDUSTRY

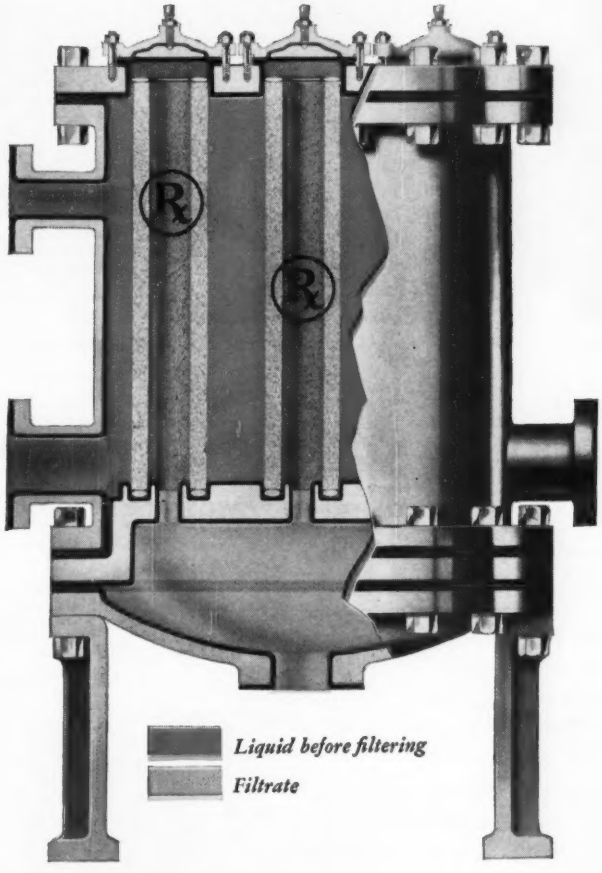
HERCULES POWDER COMPANY
INCORPORATED
952 Market St., Wilmington 99, Del. Sales Offices in Principal Cities

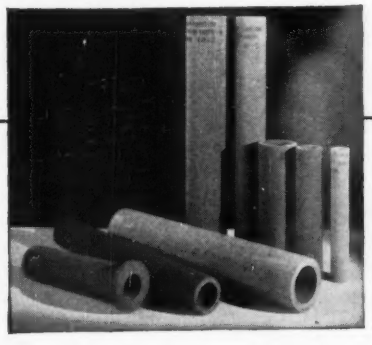
SYNTHETIC RESINS, CELLULOSE PRODUCTS, CHEMICAL COTTON, TERPENE CHEMICALS, ROSIN AND ROSIN DERIVATIVES, CHLORINATED PRODUCTS, OXYCHEMICALS, EXPLOSIVES, AND OTHER CHEMICAL PROCESSING MATERIALS.

G55-8

Another Norton Rx *on the job!*

Outstanding performance of Adams filters aided by Norton seamless porous tubes





R. P. Adams Co. Filters, covering many chemical filtering services, deliver sparkling clear filtrate and insure quick cleaning without disassembly. Adams filters handling acid or neutral solutions are equipped with Norton seamless porous tubes, *engineered and prescribed* for faster, more thorough filtering and backwashing.

Besides assuring fast, thorough filtering action, Norton porous tubes are extremely easy to clean by backwashing. Here are several good reasons why they excel in these two primary essentials of efficient, economical filter performance:

- Norton porous tubes are made of ALUNDUM* (fused alumina) *engineered* by Norton for chemical stability, inertness and other properties necessary to withstand acid, neutral and slightly alkaline liquors.
- Like all Norton ALUNDUM porous mediums they are made with the patented *controlled structure* process that assures even distribution of pores — for uniform passage of both filtering and backwashing liquids.
- They are *seamless,* providing unobstructed diffusion over their entire area — for further efficiency in both filtering and cleaning.

Other big advantages

of all Norton porous mediums include ease of installation and exceptional resistance to breakage and chipping. Available in sizes and open-pore ratios to meet your needs, they're *engineered* to last longer and cut your operating costs — and they're *prescribed* for a wide variety of chemical services, such as filtering water or solvents . . . cutting oils, wine, etc. . . . reclaiming cleaning fluids and industrial waste . . . and for boiler feed water treatment, carbonation, chlorination and other gas diffusion applications.

See your Norton Representative for further facts or write, describing your requirements, to NORTON COMPANY, 508 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

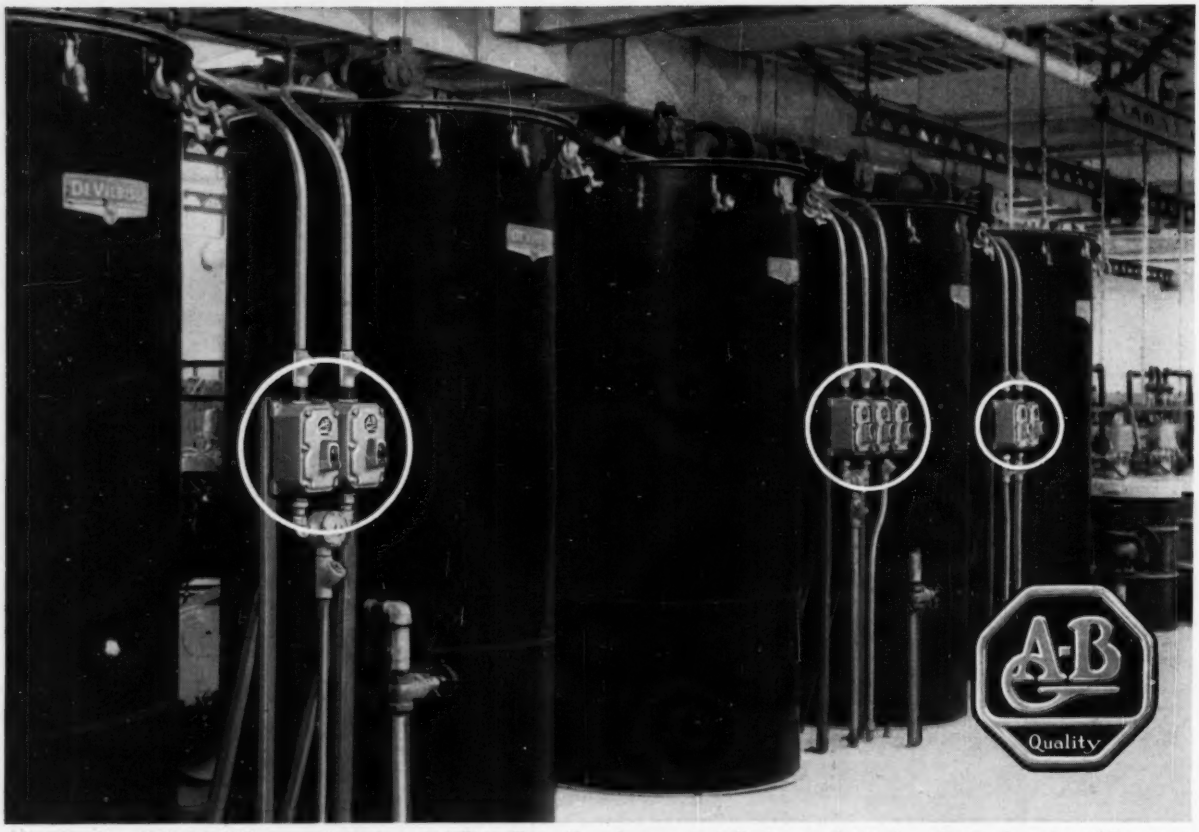
NORTON

REFRACTORIES

Engineered... Rx ...Prescribed

Making better products... to make other products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries



Allen-Bradley Bulletin 609 manual starters, in NEMA Type 7 enclosures, installed on paint tank agitators in automobile plant

PROTECT YOUR PLANT with A-B EXPLOSION-PROOF STARTERS

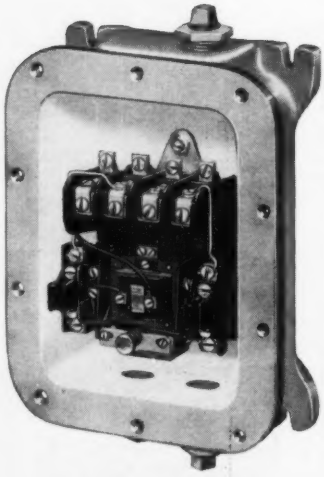
Bulletin 609 Manual Starter
This handy manual starter is in a NEMA Type 7 explosion-proof enclosure for hazardous locations. The bolted cover has a machined flange. Other types of enclosures are also available.

Where explosive atmospheric conditions create a hazard, selecting the correct enclosure for your motor control is as important as picking the starters themselves. Not only does the choice of enclosures have a far-reaching effect on the life and performance of the starters . . . and on your production schedules . . . but very often on the safety of your plant.

A wide choice of enclosures is listed in the A-B Handy Catalog for all Allen-Bradley manual and automatic starters, relays, and pilot controls. Send for this handy reference book on motor controls. Specify the correct enclosure for every operating condition in your plant.

Allen-Bradley Co.
1337 S. First St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

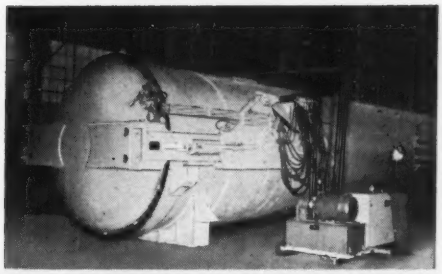
ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY

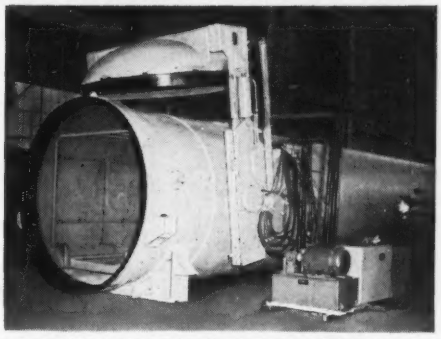


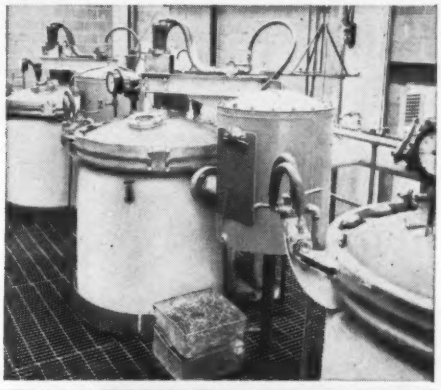
Bulletin 709 Solenoid Starter
This automatic starter is shown in a NEMA Type 7 explosion-proof enclosure, with cover removed to show the magnetically operated switch. Two thermal relays give accurate and continuously dependable overload protection.

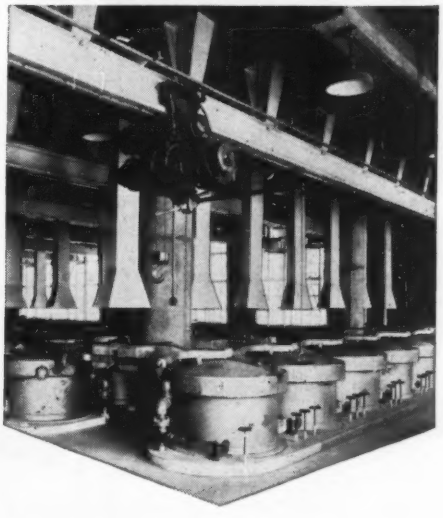
Struthers Wells

QUICK OPENING BOLTLESS DOORS PATENTED







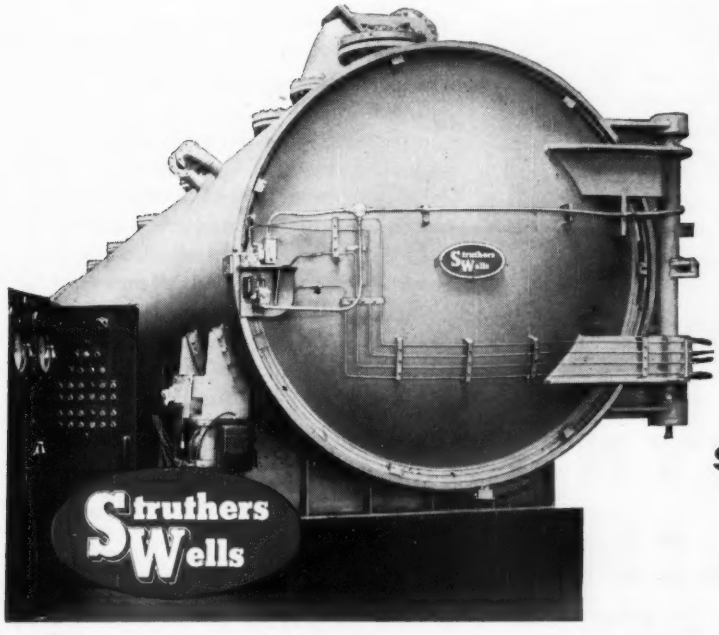


For Horizontal or Vertical Pressure Vessels

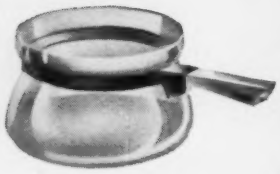
Designed and Built to Your Specifications

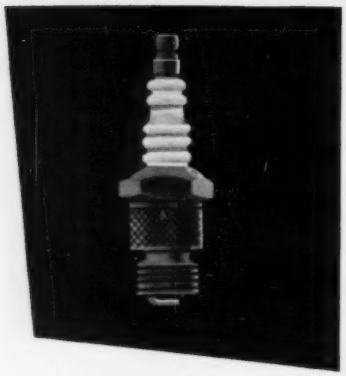
Struthers Wells' patented engineering achievements provide important advancements in Quick Opening Doors—for all sizes of vulcanizers, devulcanizers, impregnators, sterilizers, ovens, cylinders, etc. These fast, smooth-operating doors feature simplicity of design, ease of handling, savings in floor space, and a lifetime of dependability. Illustrated are a few applications of Quick Opening Doors on large and small vessels. Consult Struthers Wells for doors best suited to your specific requirements.

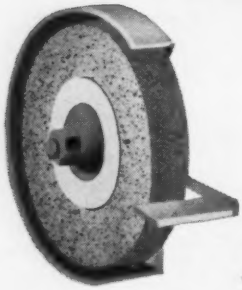
Write for Bulletin SW-553



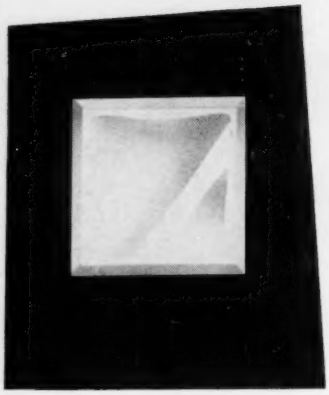
STRUTHERS WELLS
CORPORATION
TITUSVILLE, PA.
Plants at Titusville and Warren, Pa.
Offices in principal cities

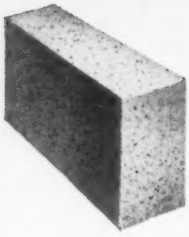


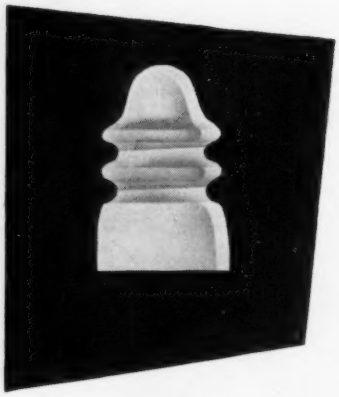




NOW! REYNOLDS Improves Calcined Alumina Without Increasing Price







R-2003 Alumina offers advantages of better quality and lowered cost to abrasives, refractory, ceramic and glass manufacturers.

Products are improved. Processes are more efficient. And these advantages cost no more, as Reynolds now offers R-2003 Calcined Alumina of top ceramic quality—and at the price of metallurgical grades. In the field of ceramics and refractories, this new product represents a lowering of materials cost.

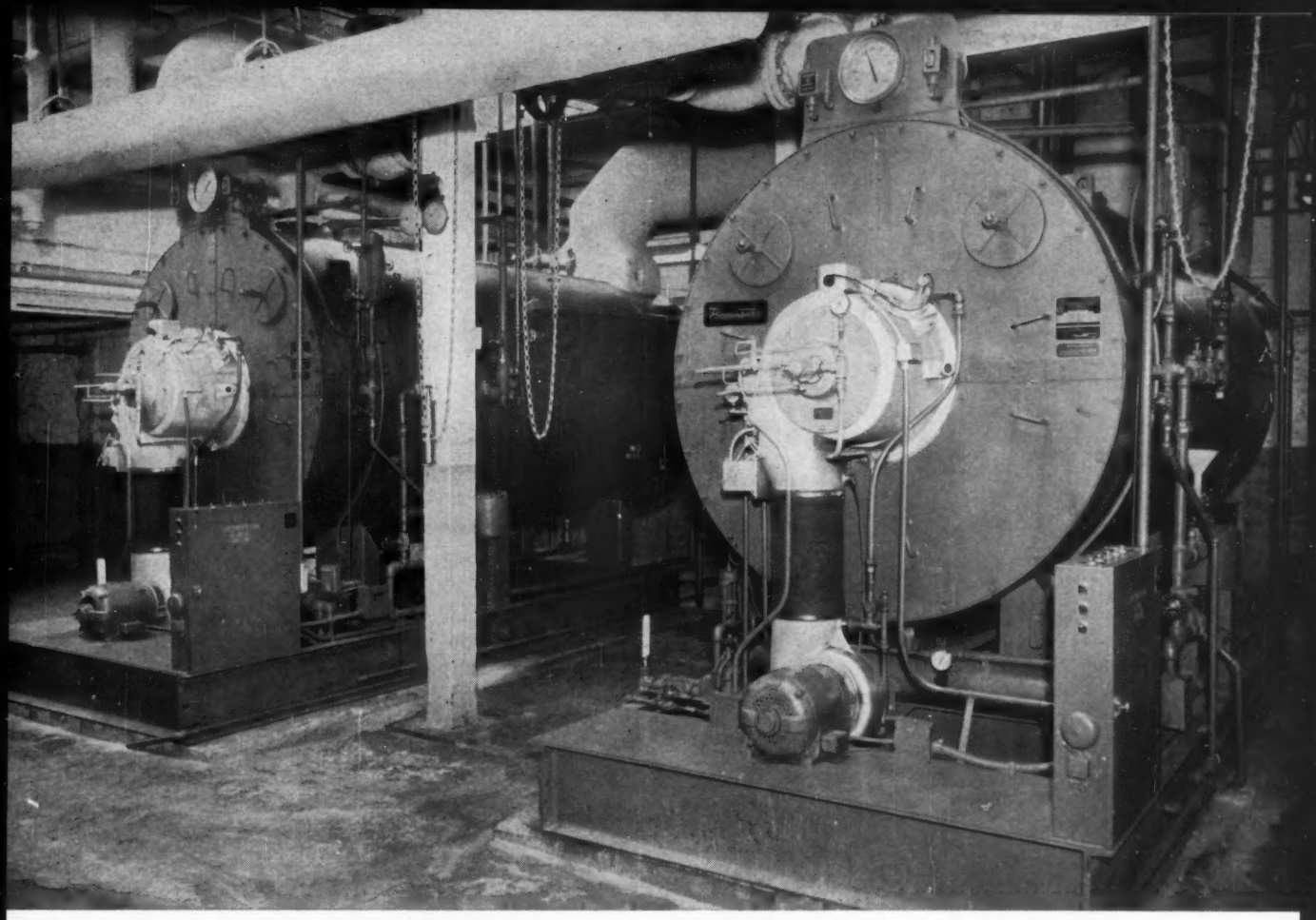
Reynolds R-2003 Calcined Alumina has lower impurities, less water, reduces dusting and minimizes shrinkage.

Following the introduction by Reynolds of all white organic free hydrated alumina at regular prices, R-2003 is further evidence of Reynolds pioneering in the chemical industry.

R-2003 Product Data Sheet is available on request. Samples for testing will be provided. For complete information on R-2003 and other Reynolds Chemicals, call the nearest Reynolds Office, listed under "Aluminum" in your classified telephone directory, or write *Reynolds Metals Company, P. O. Box 1800 CJ, Louisville 1, Kentucky.*

REYNOLDS CHEMICALS

FROM THE MAKERS OF REYNOLDS ALUMINUM



$9,040 Saving in Steam Cost

WITH *Powermaster*® PACKAGED AUTOMATIC BOILERS

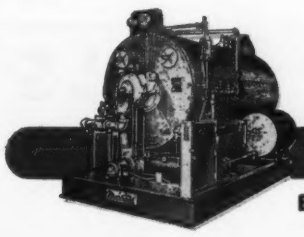
You get MORE than low-cost steam with Powermasters:

- ★ Low-cost, space-saving installation
- ★ Fast steaming
- ★ Instant response to load changes
- ★ Quick fuel change-overs
- ★ Clean, dry steam
- ★ Automatic operating and safety controls
- ★ High fuel economy at all loads
- ★ Clean, quiet operation
- ★ Smokeless combustion
- ★ One-source responsibility for complete unit
- ★ Nation-wide factory-trained service organization
- ☆ Pay-As-You-SAVE Purchase Plan

These two 200 HP *Powermaster* Packaged Automatic Boilers are saving 50% of steam costs annually for a large manufacturer of clothing. In addition, they are providing hotter, drier steam for processing and comfort heating.

Completely factory assembled and fire-tested *Powermasters* have gained world-wide acceptance as dependable producers of low-cost steam or hot water. And now, you can put a *Powermaster* in your plant or building on the Pay-As-You-SAVE Purchase Plan, that helps you pay for your new boiler out of its own savings.

Write for Bulletin 1220, or ask our representative to explain why it pays to modernize with *Powermaster*.



Powermaster®

PACKAGED AUTOMATIC BOILERS

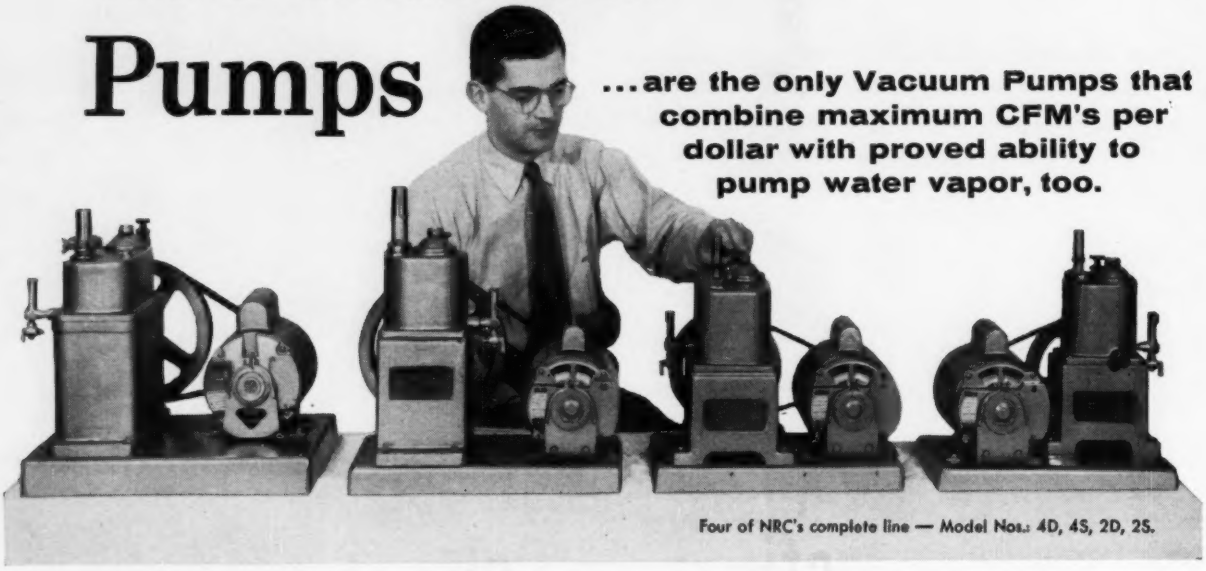
In sizes to 500 HP; pressures to 250 psi.

ORR & SEMBOWER, INC.

Established 1885 • Morgantown Road, Reading, Pa.

NRC Rotary Gas Ballast Pumps

...are the only Vacuum Pumps that combine maximum CFM's per dollar with proved ability to pump water vapor, too.



Four of NRC's complete line — Model Nos.: 4D, 4S, 2D, 2S.

USE CHART FOR PLACING ORDER— OR SEND FOR RGBP BULLETIN

Remember, *most* systems are wet in humid weather. That makes NRC pumps a *double* value! First, they deliver the finest all around pumping performance you can buy. Second, they *keep* their fast pumping cycles in all types of weather, handling all types of condensable vapors, even up to 100% moisture.

And you get all this at no additional cost! So why buy "conventional" pumps when you can get NRC's dependability and "gas ballast" feature all for the same price?

NARESCO EQUIPMENT CORPORATION

Sales Subsidiary of National Research Corp.

59 Charlemont St., Newton Highlands 61, Mass.

Sales Offices: Boston • Chicago • Cleveland • Houston
Los Angeles • New York • Palo Alto • Philadelphia
in Canada: Toronto • Arnprior

ENGINEERING DATA AND SPECIFICATIONS

Price with base, motor, belt, V-belt drive, less belt guard	Pump Model	Nominal Rated Capacity (Cubic Feet Per Minute)	Ultimate Vacuum (1) (mm Hg)		Rated Pump Shaft Speed (R.P.M.)	Motor (2) Horsepower	Approximate Oil Capacity (Pints)	Connecting Pipe Dimensions		Approximate overall dimensions Pump-Motor and Base (Inches)			Weight Pump, Motor and Base (lbs.)
			With Gas Ballast	Without Gas Ballast				Pump Inlet	Pump Exhaust	Height	Width	Length	
	Single Stage												
$ 155	NRC 2-S	1.25	Less Than One Half	3×10^{-3}	525	¼	3½ Fl. Oz.	T19/38(3)	¾(5)	16	11	16	68
$ 225	NRC 4-S	3.3		3×10^{-3}	450	¼	3½ Fl. Oz.	T29/42(3)	¾(5)	18	11	19	89
$ 312	NRC 6-S	6.75		3×10^{-3}	400	¾	7 Fl. Oz.	1¼ O.D.	1¼ O.D.	21	13	24	150
$ 448	NRC 15-S	11.6			305	1	2½ Qts.	1½ O.D.	1½ O.D.	22	18	24	270
$ 730	NRC 30-S	29.5		3×10^{-2}	400	1½	2 Qts.	2(4)	3 O.D.	29	19	31	441
$1350	NRC 100-S	100		3×10^{-2}	335	5	5 Qts.	3(4)	4¼ O.D.	43	34	45	1430
$2200	NRC 200-S	202		1×10^{-2}	340	15	3 Gal.	4(4)	4¼ O.D.	58	43	53	2750
$3573	NRC 400-S	403		5×10^{-2}	340	25	6 Gal.	4(4)	4¼ O.D.(6)	60	62	66	5775
	Compound												
$ 215	NRC 2-D	1.25	Less Than One	5×10^{-5}	525	⅛	3½ Fl. Oz.	T19/38(3)	¾(5)	16	11	16	84
$ 280	NRC 4-D	3.3		5×10^{-5}	450	1/6	24 Fl. Oz.	⅛ IPS	¾(5)	17	14	20	155
$ 425	NRC 6-D	6.75		5×10^{-5}	400	¼	14 Fl. Oz.	¾ IPS	1¼ O.D.	21	18	22	265
$ 700	NRC 15-D	14.75	2.5×10^{-2}		400	1	4¼ Qts.	1½ O.D.	1½ O.D.	21	20	25	390
	Combination												
$1080	NRC 30-M	29.5	3 x 10⁻³	—	400	1½	2 Qts.	2(4)	3(4)	40	20	35	550
$1810	NRC 100-M	100		—	335	5	5 Qts.	3(4)	3(4)	57	35	46	1800
$2930	NRC 200-M	202		—	340	15	3 Gal.	4(4)	6(4)	76	43	53	3000
$4590	NRC 400-M	403		—	340	25	6 Gal.	4(4)	—(8)	78	62	89	8400

(1) McLeod gauge, standard test procedure.
(2) Requirements for average installation.
(3) T indicates a standard taper joint, taper 1:10. First figure is the dia. (mm) of large end, second figure is the length (mm) of the ground zone.
(4) Standard 150 pound Flange
(5) Male pipe thread.
(6) NRC 400-S has two exhaust connections NRC 400-M has two 6" and one 3" 150# flanged exhaust connections.

Water Cooling — NRC 100-S, 200-S, 400-S, 100-M, 200-M, and 400-M have water jackets with ½ pipe tap connections.

Naresco Equipment Corporation

Developments in Color Measurement

GENERAL ANILINE COLORIST SAYS . . . .

"G-E Spectrophotometers Are Invaluable for Production-line Color Analysis"

"Even the most complicated color-matching problems are taken in stride by General Electric's recording spectrophotometers," says Irving W. Feyler, Colorist at General Aniline & Film Corporation, Rensselaer, New York.

Rapid production-line analysis of dyes by G-E spectrophotometers help General Aniline technicians maintain constant color control. A complete spectrophotometric curve of the most complex dyestuffs can be drawn in only 54 seconds.

MATERIAL SAVINGS are assured because costly mismatching of dyes for textile, plastic, paint, ink, paper, and other products is practically eliminated.

Versatile and accurate, the G-E spectrophotometer has a range of 380 to 700 millimicrons.* The instrument will measure both transparent and opaque samplings.

Additional savings are made by using the automatic tristimulus integrator. Provided as an accessory to the spectrophotometer, the integrator automatically calculates numerical color values at the completion of the spectrophotometric curve.

FOR MORE INFORMATION, contact your nearest G-E Apparatus Sales Office, or write for bulletin GEC-307 to General Electric, Section 585-18, Schenectady 5, N. Y.

*Special ranges can also be provided.

GENERAL ELECTRIC

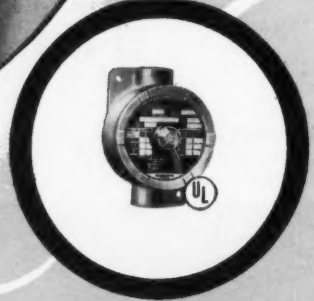
1. INSERTING SAMPLE and standard color specimens into G-E spectrophotometer, operator prepares to run test.

2. SELECTING RECORDING SPEED is next step. Color measurement is automatically recorded by G-E instrument.

3. ANALYSIS AND COMPARISON of test and standard curves is final step in accurate production-line color control.

NOW... complete, explosion-proof lighting

Type EVA Explosion-Proof Lighting Fixture
200-Watt, with or without guard or reflector.
Overall length: 13-3/16"



Type FSPC Explosion-Proof Tumbler Switch Condulets
in 1, 2, 3-pole; 3 and 4-way; DP DT (no "off") styles.

NO AIR PRESSURE NEEDED! Since Type EVA contains the explosion rather than preventing it, no "pumping up" is required. Nor is there any pressure switch to fail and possibly create a hazardous condition. Also, fixture need not be removed from the hazardous area to re-lamp. Merely switch off the circuit – unscrew globe holder – replace lamp. Less maintenance, *easier* maintenance and much lower initial cost are plus features of this new explosion-proof Crouse-Hinds Lighting Fixture.

installations for acetylene and hydrogen areas!

CROUSE-HINDS

CONDULETS®

UL-Approved for Class 1, Groups A & B Locations

From switch to lighting fixture, Crouse-Hinds' is the first *complete* lighting system designed and UL-approved for Class 1, Groups A & B, as well as C & D hazardous locations.

These explosion-proof fixtures and Condulets are entirely new – provide greater installation flexibility. Fixtures may be re-lamped – *even in the presence of combustible gases* – since gas-tightness is *not* a requirement for their safe performance. And they *are* safe . . . their heavier, more shock-resistant construction withstands the pressure of internal explosions without rupturing . . . their flame-tight joints prevent the escape of flames of flammable atmospheres.

✻ Whether you're installing a complete explosion-proof lighting system – or merely converting a few of your Group C or D fixtures to these safer Group A's – your Crouse-Hinds Distributor can be a definite help. See him. Or write us.

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

CROUSE-HINDS COMPANY

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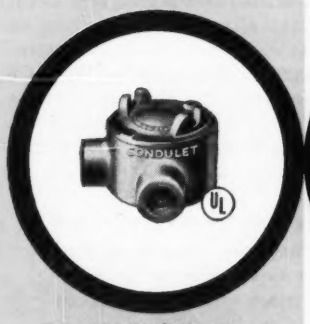
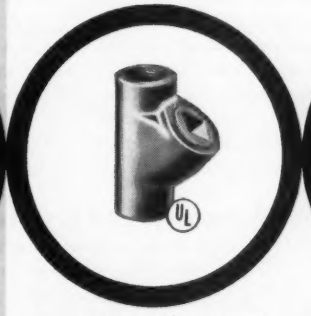
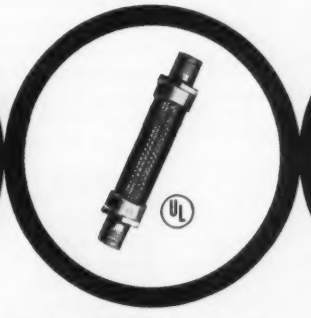


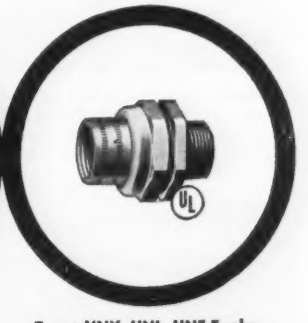
Type EAB Explosion-Proof Junction Condulets in ½", ¾" and 1" hub sizes—through feed, L, T and X hub arrangements.



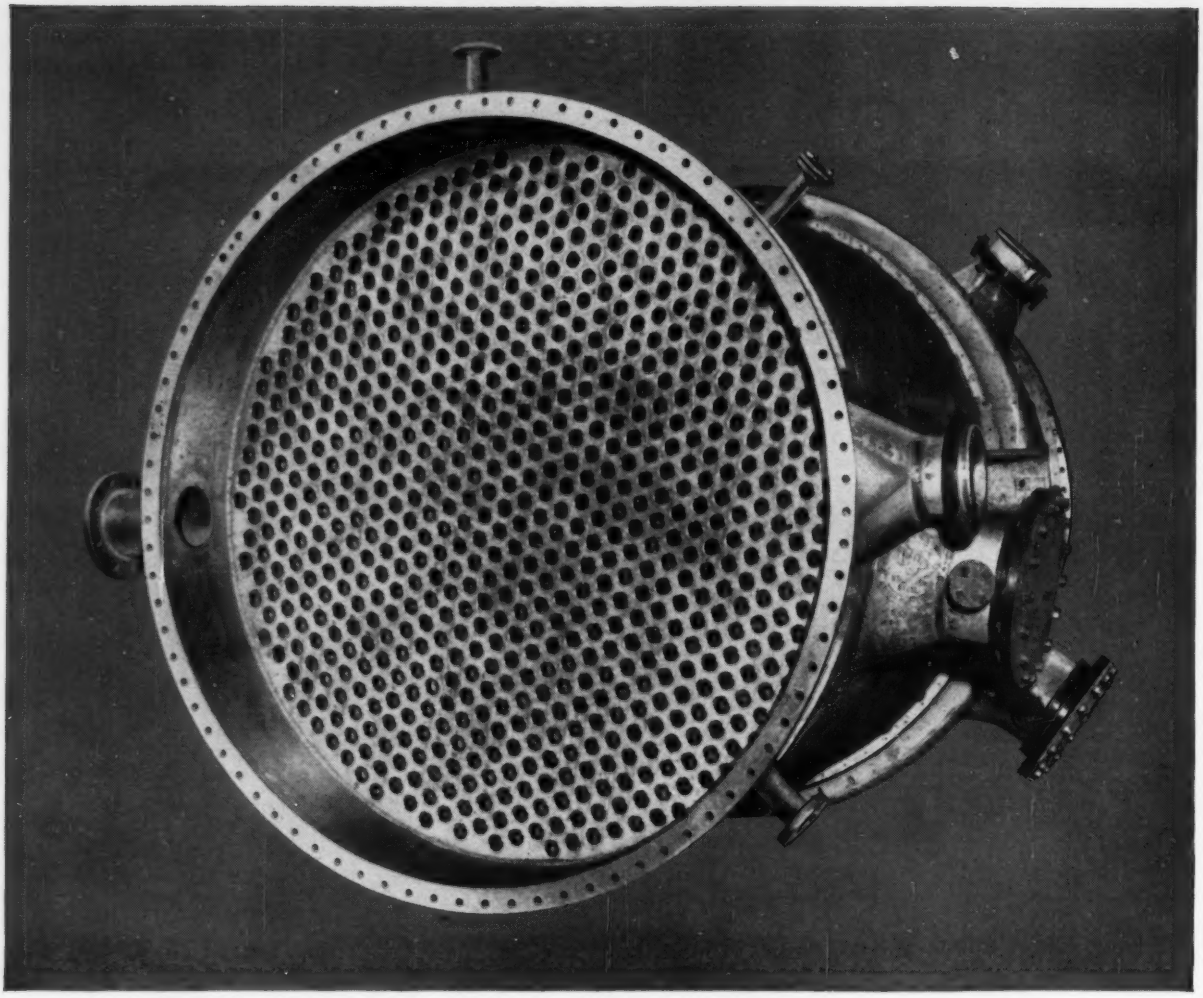
Type EYS Explosion-Proof Sealing Condulets in ½", ¾" and 1" hub sizes.



Type EC Explosion-Proof Flexible Couplings and fixture supports in ½" and ¾" sizes.



Types UNY, UNL, UNF Explosion-Proof Condulet Unions female and male styles in ½", ¾" and 1" sizes.



Stainless steel converter—7′ 6″ O.D. by 12′ 6″, face to face of flanges. Equipped with 745 tubes 2″ in diameter by 10′ 0″ long.

How Downingtown Skill and Experience Assure Quality Processing Equipment for Your Plants

Generator air pressure tank built at Downingtown of carbon steel—8′ 0″ I.D. x 23′ 8″ overall. Designed and tested for 200 pounds W.P. End plate approximately 8″ thick.

Aluminum cyclone separator, 6′ 6″ O.D. x 30′ 11″ long. Fabricated at Downingtown of type 52S aluminum.

Fabricating the complex pressure vessels which turn flow charts into profitable process plants has been the specialized business of Downingtown Iron Works for many years. We've accumulated the skill and experience required to fabricate accurate, smooth-working process equipment to meet your specifications. We pioneered in the application of stainless steel and other alloys for corrosion-resistant pressure vessels.

We've developed efficient welding techniques—approved for ASME Code work—which assure sound, neat, extra-strong welds. We're skilled at working and welding many alloys and clad steels, as well as the carbon steels and stainless steels. Our new bulletin PF pictures dozens of chemical process pressure vessels fabricated at Downingtown. Write for your copy today.

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Downingtown Iron Works, Inc.

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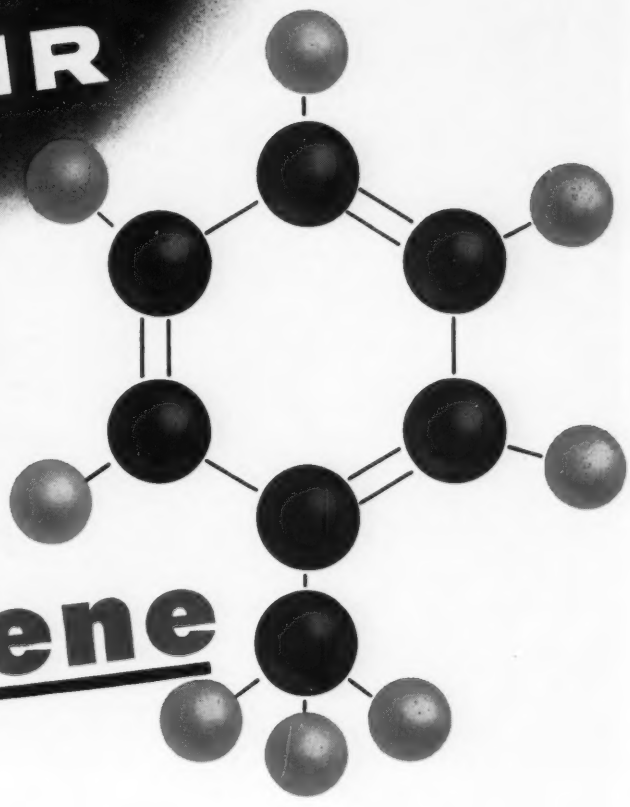

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Do your manufacturing processes call for high-purity aromatic hydrocarbons, including toluol, xylol, paraxylene, and heavy aromatic solvents? If so, Sinclair has the answer to your needs.

Sinclair's newest chemical unit, recently completed at Marcus Hook, Pa., has been especially designed to provide dependable supplies of aromatic chemicals for industry. The operation of this modern Sinclair unit marks another step forward in Sinclair's progress in the petro-chemical field.

Why not investigate this new source of supply *today?* Write or call—

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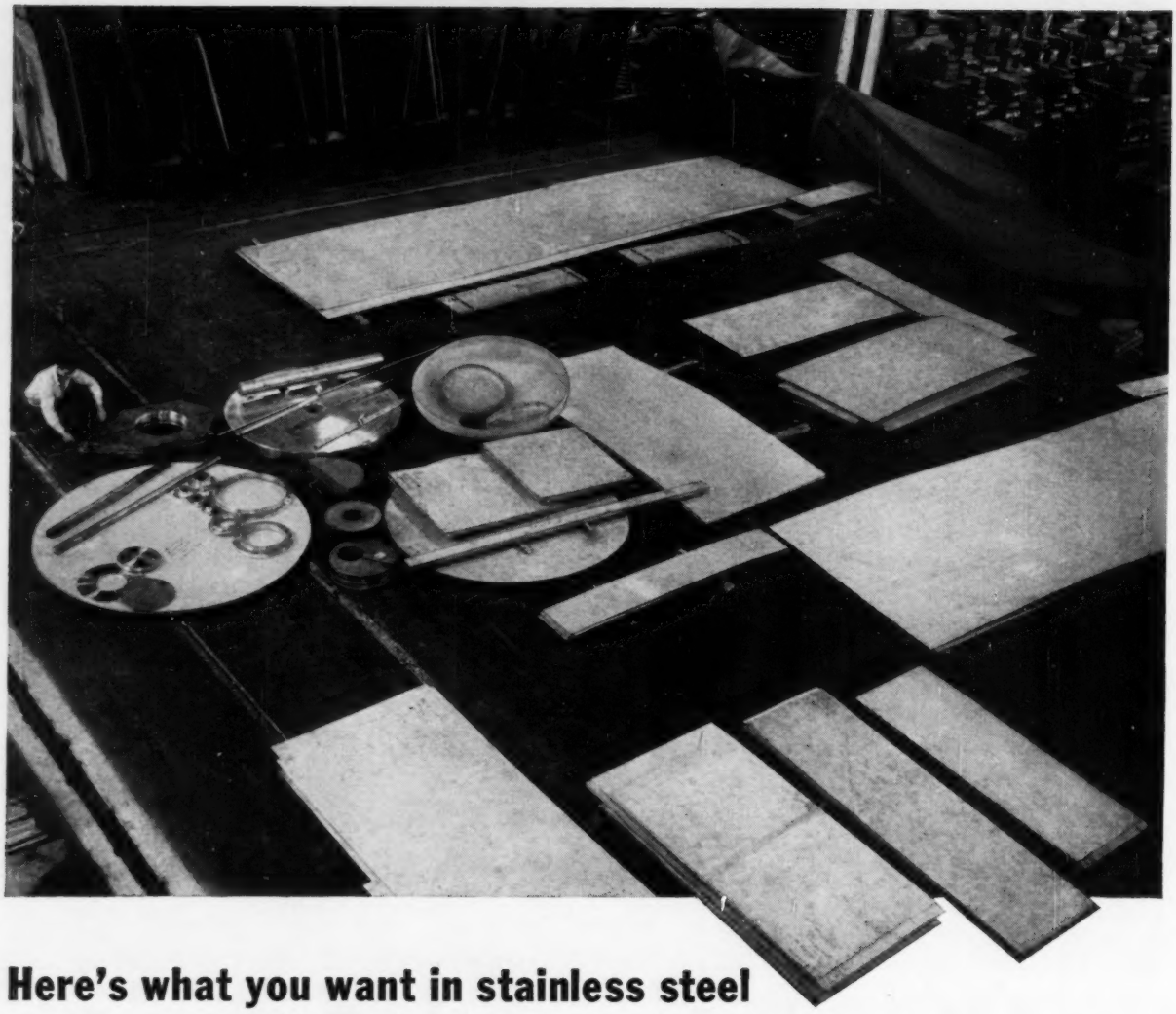

Here's what you want in stainless steel —the way you want it

Stainless Steel Plate . . . produced to almost any size or thickness, 3/16" and heavier, in rectangles or cut-to-shape. Carlson maintains what is probably the largest stock of stainless plate in the country—produced to highest chemical and metallurgical standards —ready for cutting to your requirements, and for shipment when you want it.

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Complete Service . . . At Carlson the emphasis is on flexibility, efficiency and economy in producing what you want, when you want it. If you would like additional information about our service and products or, if you want *to place an order*—just let us know, we promise you prompt action!

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... as compared to the blower that keeps air fresh

Your men can't produce at top efficiency when stagnant, hot or fume-filled air robs them of their energy.

Wherever bad air slows down production . . . in shipholds, tanks, drums, boilers or other places where men need fresh, cool air . . . a Coppus Blower becomes both a safety device and a production tool.

Portable and easily adaptable for special purposes, Coppus "Blue Ribbon" Blowers and Exhausters fit all your "fresh air" requirements. The Coppus "Blue Ribbon" means premium performance at ordinary cost. Check and mail the coupon for specific information. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, BEST'S SAFETY DIRECTORY, MINING CATALOGS.

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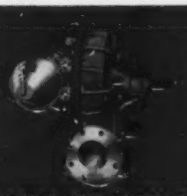
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Six frame sizes —
1 to 150 horsepower

VERTICAL TURBINE
Six frame sizes —
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MAIL THIS COUPON To Coppus Engineering Corp., 229 Park Avenue, Worcester 2, Mass.

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- ☐ In tanks, tank cars, drums, etc.
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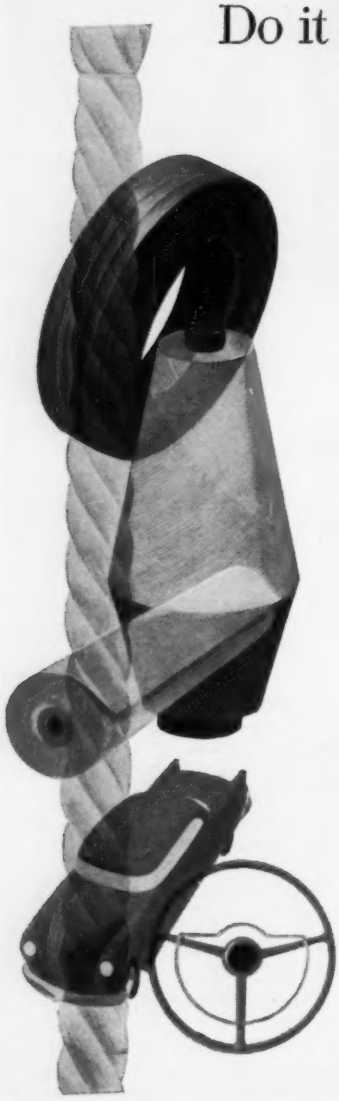
(Write here any special ventilating problem you may have.)

Handling

cellulose acetate · acrylics · acrylonitrile polyamides (nylon) · rayon synthetic resins · formaldehyde ?

Do it better, cheaper...with

ALCOA ALUMINUM



CELLULOSE ACETATE has no action on aluminum. ALCOA Aluminum tankage, piping, trays, rotary driers, fume ducts, hoods and conveyors are used in the production of cellulose acetate. ALCOA Aluminum is also being used successfully in acetylators, precipitators, washing equipment, dephlegmators, stills, condensers and evaporators.

CELLULOSE ACETATE BUTYRATE is handled in aluminum silos, piping and conveyors. ALCOA Aluminum does not discolor the product and is nonsparking.

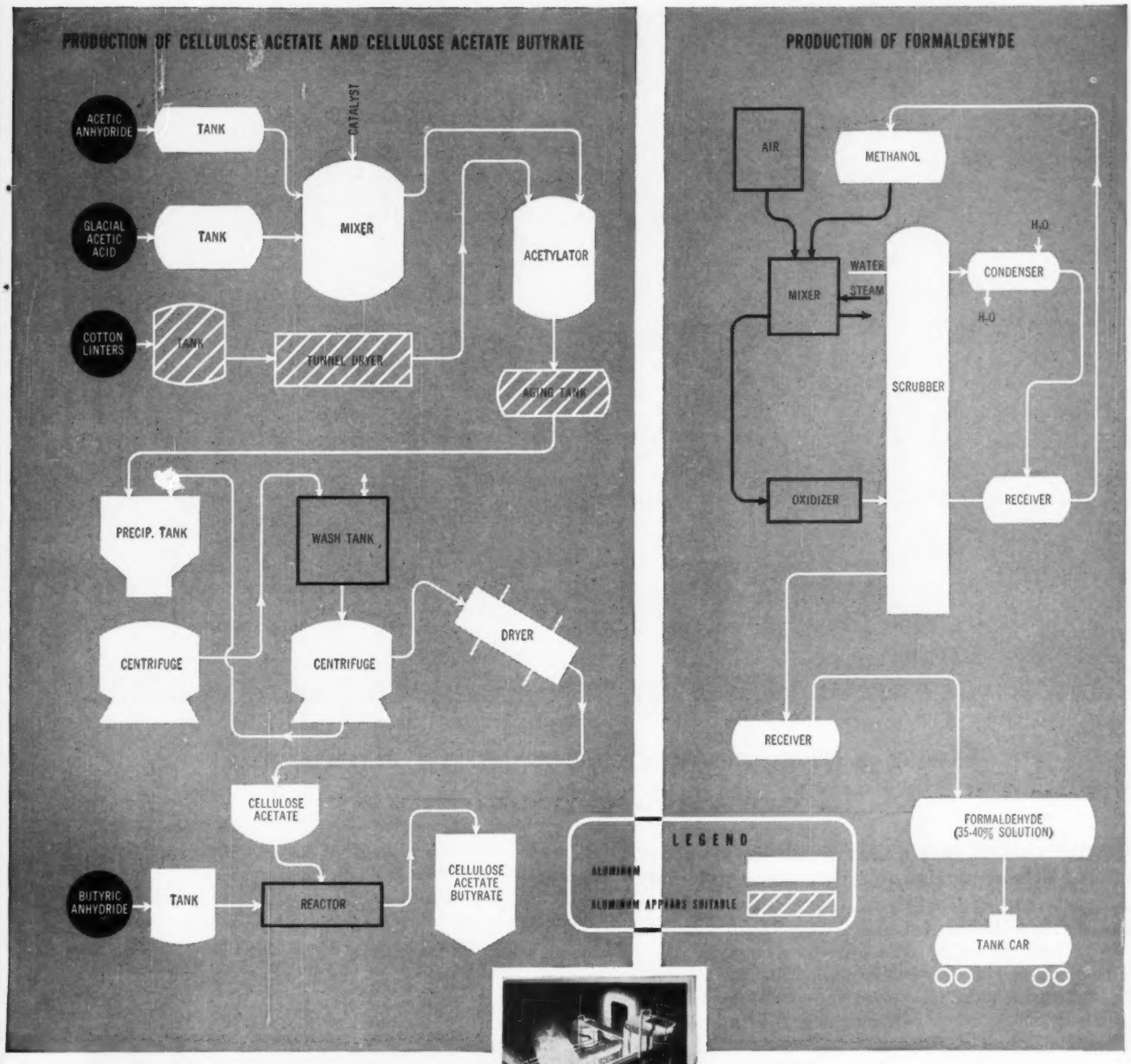
ACRYLICS are successfully handled in storage tanks, heat exchangers, distillation towers, reactors, piping and textile machine parts made of ALCOA Aluminum.

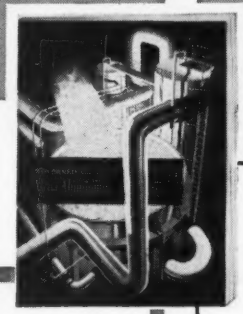
SYNTHETIC FIBERS, as well as their ingredients, are handled in ALCOA Aluminum process equipment and tankage. In the production of *nylon*, for example, aluminum storage tanks, tank cars, piping and textile machine parts are used. The *rayon* industry makes extensive use of ALCOA Aluminum, including aluminum hoods, ducts, desulfurizing equipment, piping, tubing, extractors, pallets, conveyors, precipitators, traverse bars, guide holders, gear covers, separator blades, reel frames, emulsion rolls, spinning compartment covers, spools and buckets.

ACRYLONITRILE has no action on aluminum even in the presence of moisture. ALCOA Aluminum distillation, piping and storage facilities are used to prevent the discoloration of the product.

SYNTHETIC RESINS for the production of *plastics* are handled in ALCOA Aluminum storage tanks, stills, condensers, receivers, piping, heating coils, weighing tanks and reaction vessels.

FORMALDEHYDE, when pure, has no action on aluminum. ALCOA Aluminum distillation towers, scrubbers, storage tanks, piping, heat exchangers, shipping drums and tank cars are in service. Commercial formalin solutions may cause an initial self-stopping attack.





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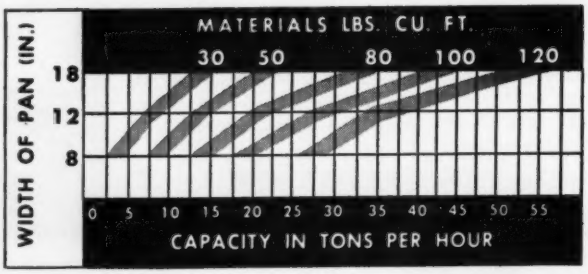
Here's the new cost-cutting answer to conveying problems!

Immediate Delivery on Hewitt-Robins Springmount Vibrating Conveyor Systems to Handle Almost Any Material . . . For Unlimited Distances . . . With Minimum Power Requirements!

The new, low-cost Hewitt-Robins Springmount Vibrating Conveyor is the answer to your materials handling problems. Designed for efficiency in action, the balanced-vibration principle of this new conveyor unit results in low dynamic loads . . . units up to 100 feet run on just a one horsepower drive! Compared to other conveying mediums the new Hewitt-Robins Springmount Vibrating Conveyor provides not only low initial cost, but later savings in operation and maintenance!

These conveyors are job-proven to be rugged! Gentle, even hopping action up to 50' per minute, the standard 4" troughed pan will carry materials; sub-freezing to 500° F.—lump or fines—wet or dry—loose or packaged—dense or porous—malleable or brittle! Special pans are available for temperatures up to 1200° F. and for severely abrasive or corrosive materials.

Hewitt-Robins Springmount Conveyors are adaptable . . . standard pan widths of 8", 12" and 18" are available in lengths from 10' and up, in standard easy-to-assemble prefabricated units . . . dividers, gates and intermediate discharge points allow flexible combinations on any conveyor operation . . . assured power-economy, in that one horsepower drives 100' of 8" pan, 80' of 12" pan or 60' of 18" pan!



Get more detailed information on the versatile Springmount Vibrating Conveyor! Contact your nearest Hewitt-Robins agent or distributor . . . or write today to Dept. VC-1, Hewitt-Robins Inc., Stamford, Conn.

Hewitt-Robins

Conveyor Belting—Conveyor Machinery—Industrial Hose—Vibrating Screens—Vibrating Conveyors—Design, Manufacture, Engineering and Erection of Complete Bulk Materials Handling Systems.

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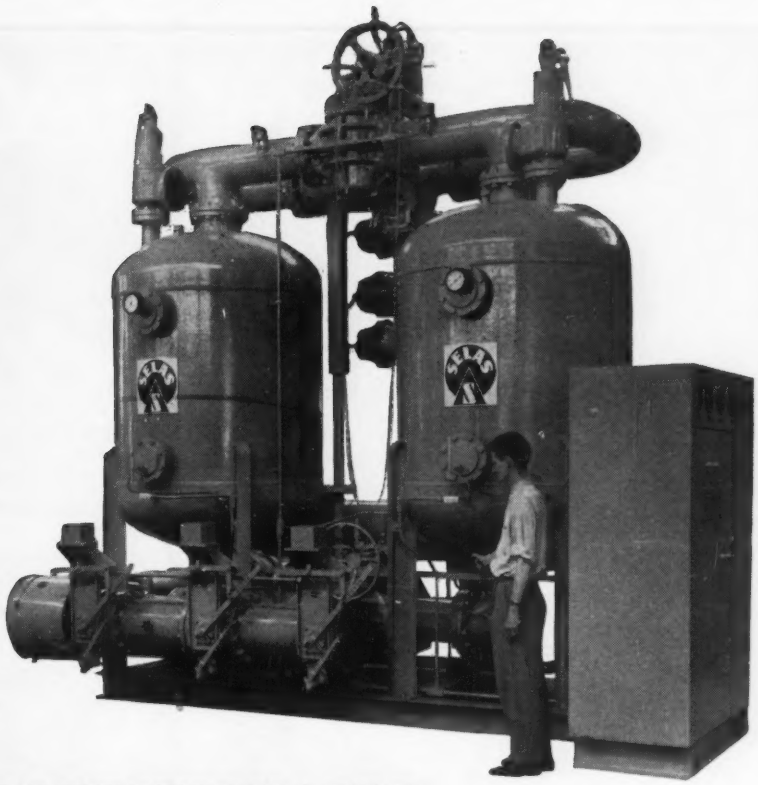
SELAS DEHYDRATOR



Semi-automatic, continuous-duty Selas Dehydrator; capacity 14,500 scfm air at 150 psig.

AUTOMATIC PROTECTION FOR AIR AND GAS SYSTEMS

Other SELAS UNITS FOR AIR-GAS PROCESSING

LIQUI-JECTOR
continuously removes water, water-oil emulsions and dirt particles from air, gas and steam.

VAPE-SORBER
for continuous removal of water, water-oil emulsions, dirt and petroleum vapor from air and gases.

... COMPRESSED AIR, PROCESS GASES DRIED CONTINUOUSLY ... AUTOMATICALLY ... WITH SELAS DEHYDRATOR

Compressed air, carbon monoxide, carbon dioxide, hydrogen, oxygen, gaseous hydrocarbons, inert gases are dried effectively ... economically ... in Selas Dehydrators which are designed for all conditions of processing.

- Desiccants employed are selected to meet moisture-removal requirements. Dewpoints less than −100° F are readily achieved.
- Reactivation by steam, gas or electric heat.
- Operating pressures range from atmospheric to 6000 psig.
- Inlet temperatures up to 140° F accommodated without refrigeration.

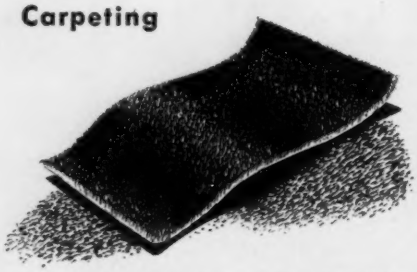
Selas Dehydrators are available for manual, semi-automatic and fully automatic operations, in capacities varying from 10 to 15,000 scfm.

Write for informative bulletins on "AIR-GAS PROCESSING."

SELAS FLUID PROCESSING

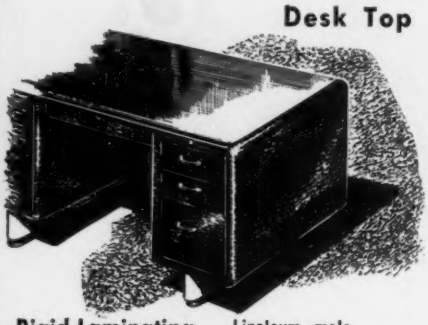
CORPORATION OF AMERICA • PHILADELPHIA 34, PA.

Carpeting



Flocking — Natural or synthetic fibres, ¼ to 1 mm. long, cemented to fabric, paper, rubber, plastics, metals, wood, etc. to produce the effect of pile, suede, velvet or plush.

Desk Top



Rigid Laminating — Linoleum, melamine-type or vinyl plastic top-sheeting permanently bonded to steel and wooden desks.

TV Casing

Permanent Bonding — High fashion element introduced to TV units through the laminating of colorful vinyl to metal casing.

Tarpaulin

Bonding and Sealing — Canvas tarp sections positioned for stitching with the aid of cement. Later, stitched area is treated with sealer for waterproofing.

One Thing in Common . . .
Angier Adhesives

FOR EVERY INDUSTRY
Latest Developments in Adhesives for Honeycomb Construction and Mylar Film Bonding

ANGIER PRODUCTS INC.

Rubber, Latex and Resin Cements
Pressure Sensitive Cements
Laminants and Sealants
Tie Coats
Resin Emulsions

Here you see just a hint of the countless ways Angier Adhesives contribute to the manufacture of U.S. and foreign goods.

Industry has learned to count on Angier for new economy and effectiveness in joining and fastening *all kinds* of materials.

How do adhesives fit into your picture? The answer might prove to be a very profitable surprise. You will never know until you talk to an Angier Products man. May we make an appointment?

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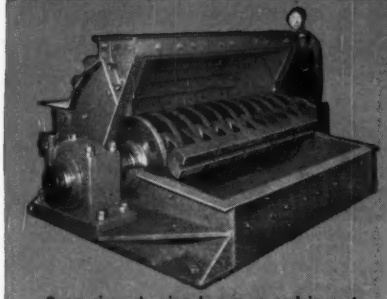
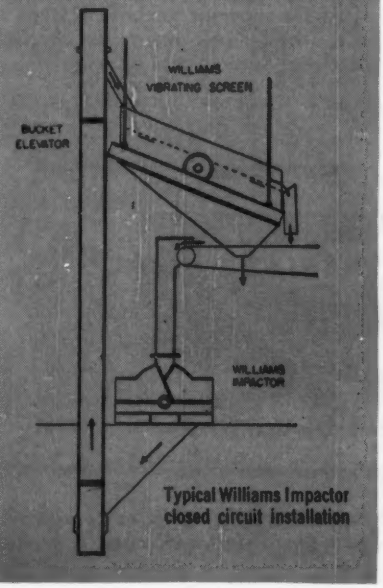
Lowest-Cost Crushing

with better product control



Open view showing hammers and impact blocks. Extremely rugged, heavy construction of steel plate with manganese steel liners, hammers and impact blocks. Extra large shafts are mounted in oversize bearings sealed in self-aligning housings.



Typical Williams Impactor closed circuit installation

WILLIAMS *Reversible* IMPACTOR

By properly controlling the forces of speed and mass in size reduction operations, Williams Impactors offer the lowest possible cost-per-ton in producing top quality materials from 2″ down to 35 mesh with a minimum of fines . . . or much smaller where more friable products are handled. In closed circuit systems with external vibrating screens, a single Impactor promises 100% product sizing with surprising economy, even with the most difficult specifications.

No grates are required, hence no replacement expense of these parts is necessary. Quick, uniform reduction, sizing and discharge from the mill eliminates any grinding attrition action that causes excessive wear, especially if raw materials are highly abrasive. Reversible rotation eliminates manual turning of hammers and minimizes down time. Impact blocks are also reversible which further reduces cost. Parts last up to 7 times longer than in other types of equipment. Unusually low maintenance is a feature of the Impactor.

You have much to gain in lower costs and better product quality control with an Impactor. *Write for literature.*

WILLIAMS PATENT CRUSHER & PULVERIZER CO.

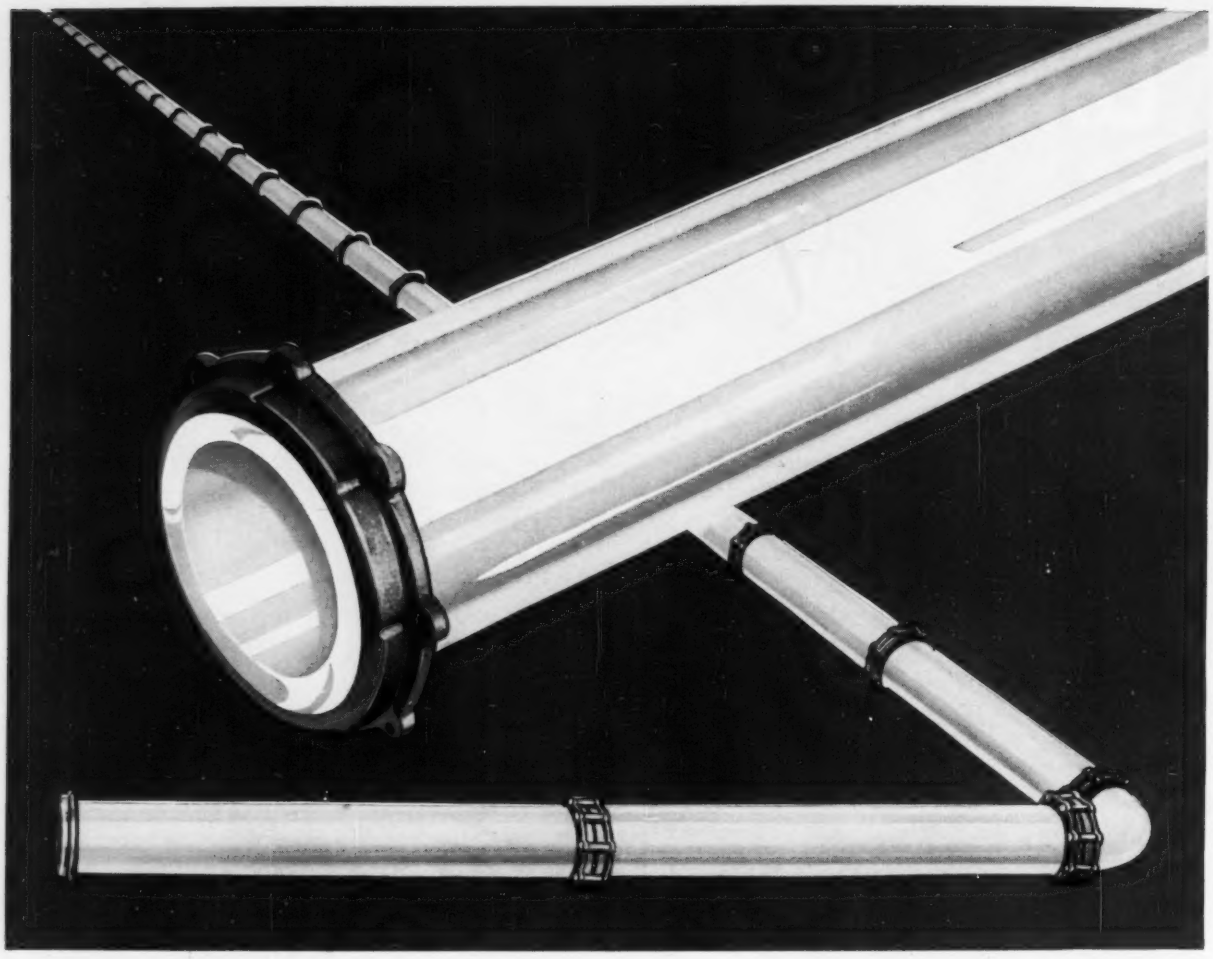
2706 N. 9th St. **St. Louis 6, Mo.**

WILLIAMS

CRUSHERS GRINDERS SHREDDERS

Hammer Mills Helix-Seal Mills Roller Mills Air Separators Vibrating Screens Feeders

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD



For some applications ONLY CHEMICAL CERAMICS *will do*

For only chemical ceramics will resist all acids, alkalies and all solvents (with the exceptions of fluorides and hot caustics). White chemical porcelain, in particular, offers important processing advantages. In addition to its chemical inertness, white chemical porcelain is completely non-toxic and non-contaminating. Its smooth glazed surface makes cleaning a matter of minutes. It can be fabricated in one-piece construction into vessels of practically any shape and in sizes from a thimble to a thousand gallon tank. Many items of equipment, such as pipe, valves, fittings, sinks, filters and storage vessels are standard items carried in stock and ready for immediate shipment. Other items can be fabricated on short notice.

The United States Stoneware Company has been one of the world's principal producers of chemical ceramics for more than ninety years. Continual research and improved manufacturing techniques give today's chemical ceramics characteristics far superior to those of even a few years ago: better heat-shock resistance, higher mechanical strength, closer dimensional tolerances.

Better take a fresh look at chemical ceramics. It may pay you well. *Write today for Bulletin C-5.*

PRODUCT OF
U.S.
STONEWARE
PROCESS EQUIPMENT DIVISION

491-D

Other Corrosion-Resistant materials manufactured and fabricated by U. S. Stoneware and its affiliated companies, include: TYGON Plastics, Duralon Resins, natural and synthetic rubber products, lead-lined equipment, adhesives and organic bonding agents, acid-brick and cements, and sintered metallic oxides.

SEPTEMBER
1955

Chementator

Edward T. Thompson

● **Watch for clash over new Cleveland air pollution law providing stiff fines for violators. It's drafted but politics dictate no action before fall elections. Meanwhile, some often-offending chemical makers there are secretly battling to pull its teeth.**

● **Planning to make 1-2 million lb./yr. of dimethyl sulfoxide (Chementator, Feb.) and 2-3 million lb./yr. of sulfonated detergent bases, Stepan Chemical has acquired a 287-acre site near Joliet, Ill. Two or three other new units are also in the works.**

New chemical family hits big time

August 1955 will live long in the memory of Commercial Solvents Corp. For at Sterlington, La., late last month, after 20 years of development work, the company started the world's first commercial production of nitroparaffins, a new family of chemicals tagged by CSC as rivaling coal tar derivatives in scope and magnitude.

The new plant cost $5 million, including a soon-to-start-up unit that can make several hundred NP derivatives. Main products will be up to 10 million lb./yr. of nitromethane, nitroethane and 1- and 2-nitropropane. Derivative possibilities are essentially unlimited, but initial emphasis will be on aminohydroxy and hydroxyl ammonium compounds.

Potential uses of these chemicals are legion. The four nitroparaffins are excellent solvents for such substances as cellulose esters and vinyl resins and will also be used in numerous syntheses. The aminohydroxys are valuable synthesis chemicals and, in the form of their soaps, are emulsifying agents. Metal ion reduction and various syntheses seem the most likely applications for the hydroxyl ammonium derivatives right now.

CSC's process is, of course, brand new on a big scale. Using 12 different unit operations, it's a real chemical engineering accomplishment.

The basic step is vapor-phase nitration of a hydrocarbon—in this case propane at 750-850F.—with nitric acid. This is done in an adiabatic, multiple-acid-spray nitrator. The NO_2 group replaces primary, secondary and tertiary hydrogen atoms (if all are present), plus all possible alkyl radicals, giving a variety of end products that are purified, then separated by distillation.

Is half a shortage still a shortage?

That's not a question for semanticists, but one that chemical management must answer to its own satisfaction on technical personnel.

And new evidence is out—the National Science Foundation's latest manpower bulletin, "Shortages of Scientists and Engineers in Industrial Research." It's based on a Bureau of Labor Statistics survey of 200 firms that do the bulk of industrial R&D (Chementator, July).

Here's the over-all summation: 33% of the companies had substantial shortages, 17% had minor ones and 50% had none. Only aircraft firms were unanimous in reporting shortages. Among the 33 chemical makers queried, 50% had no shortages, 30% had minor ones and only 20% had major lacks that are retarding research programs. Most big chemical companies are in the first bracket, though these did report using more intensive recruitment. Companies were not asked if they had a surplus of researchers.

Contradicting evaluations are rampant. "The supply of qualified research scientists and engi-

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neers . . . falls far short of industry's needs," said one top official. But countered another: "It just looks like some companies pay more than others."

The report admits that salaries, varying personnel requirements and working conditions affect a firm's turnover rate. But detailed information on these points couldn't be developed "within the limits of the present survey." Which causes many observers to feel that the Foundation might well have waited until its full report on U. S. industrial research was completed rather than raise more questions on the supply of technical manpower than it can answer at the present time.

Wave goodbye to fast tax writeoffs

There's little likelihood that many more chemical expansions will be aided by the fast tax writeoffs firms have been getting since 1950. Though the accelerated amortization program will go on, it will be used only for new plants that are "direct defense" or "direct defense-supporting."

Few chemical goals fall here. They're mostly "defense-related," which probably won't get further help. Included in this list are glycerine, by-product coke, titanium, synthetic methanol.

About the only chemical process industry goal that will still get tax benefits is petroleum alkylate. But here this inducement hasn't been sufficient, so the government has been awarding purchase-guarantee contracts, agreeing to buy production not sold on the open market. Latest of these contracts was on a $26 million butadiene-avgas plant to be built by Texas Butadiene & Chemical Corp. near Houston, (see page 118).

Perhaps the only chemical fast tax writeoffs still expected are the one-of-a-kind certificates like a recent one for rocket propellants (reportedly an intermediate for 2, 2-dinitropropane). Ethyl Corp. can write off the entire $4 million cost of a plant at Baton Rouge in five years if the project goes through.

Huge aluminum expansions planned

Reynolds Metals, Revere Copper and Olin Mathieson are poised for expansions that will boost annual aluminum capacity by 255,000. And a fourth firm, Alcoa, is set to build a $35 million plant to make 500,000 tons/yr. of alumina.

Reynolds' plans encompass an all-new plant in northwestern Kentucky for 100,000 tons and expansions at Lister Hill, Ala. (25,000 tons), and Corpus Christi, Tex. (10,000 tons). Total cost will be $200 million, including new alumina facilities, new bauxite mines and a giant coal-burning power plant.

Revere Copper has asked for a fast tax writeoff to cover a $52.7 million plant at Wenatchee, Wash. No capacity is specified.

Olin Mathieson will likely built at Morgantown, W. Va., and has received a fast tax writeoff covering 85% of a $74 million, 60,000-ton/yr. primary aluminum plant. During the Korean War Olin received a certificate on a 110,000-ton/yr. plant, but decided to abandon the project when the government refused to give a loan guarantee.

(Other planned but not-started aluminum plants are a 66,000-ton project by St. Joseph Lead and Pittsburgh Consolidation Coal, and a much-delayed 54,000-ton plant by Harvey Aluminum.)

Alcoa isn't planning any new primary capacity now, but since 1950 has completed or started over 250,000 tons of new annual capacity, requiring 500,000 tons of alumina a year. The proposed new facilities would meet this need. But they're contingent on construction of a proposed (and virtually certain) 30-ft. navigation channel in Matagorda Bay by the U. S. Corps of Engineers.

Dry cheaper with superheated vapor

Just starting operations is a novel dryer that may open a new era in drying. Built by Wyssmont Co., Long Island City, N. Y., it dries with superheated vapors of the water or other liquid being evaporated. First installation is a semicommercial unit in the Midwest that's drying a micron-sized inorganic material from 85% water down to 2-3%.

Results are technically spectacular. Heat required per pound of moisture evaporated is roughly two-thirds that needed with an air dryer; area exposed to drying is only half as great; and dust loss is entirely eliminated.

Though the idea of superheated vapor drying is not completely new, this is its first practical use on wet filter cakes and granular materials.

Actually the dryer is almost conventional. A standard Turbo dryer is equipped with gas-fired, radiant-tube heaters instead of the usual steam heating tubes. There's no intentional air intake and air initially in the dryer is expelled with the vented vapor so the dryer atmosphere soon becomes one of superheated vapor at about atmospheric pressure. This vapor is recirculated many times over the radiant tubes and reheated to a relatively high temperature.

Heat transfer to the material is almost solely by convection from the vapor, with little radiation.

(Continued on page 108)

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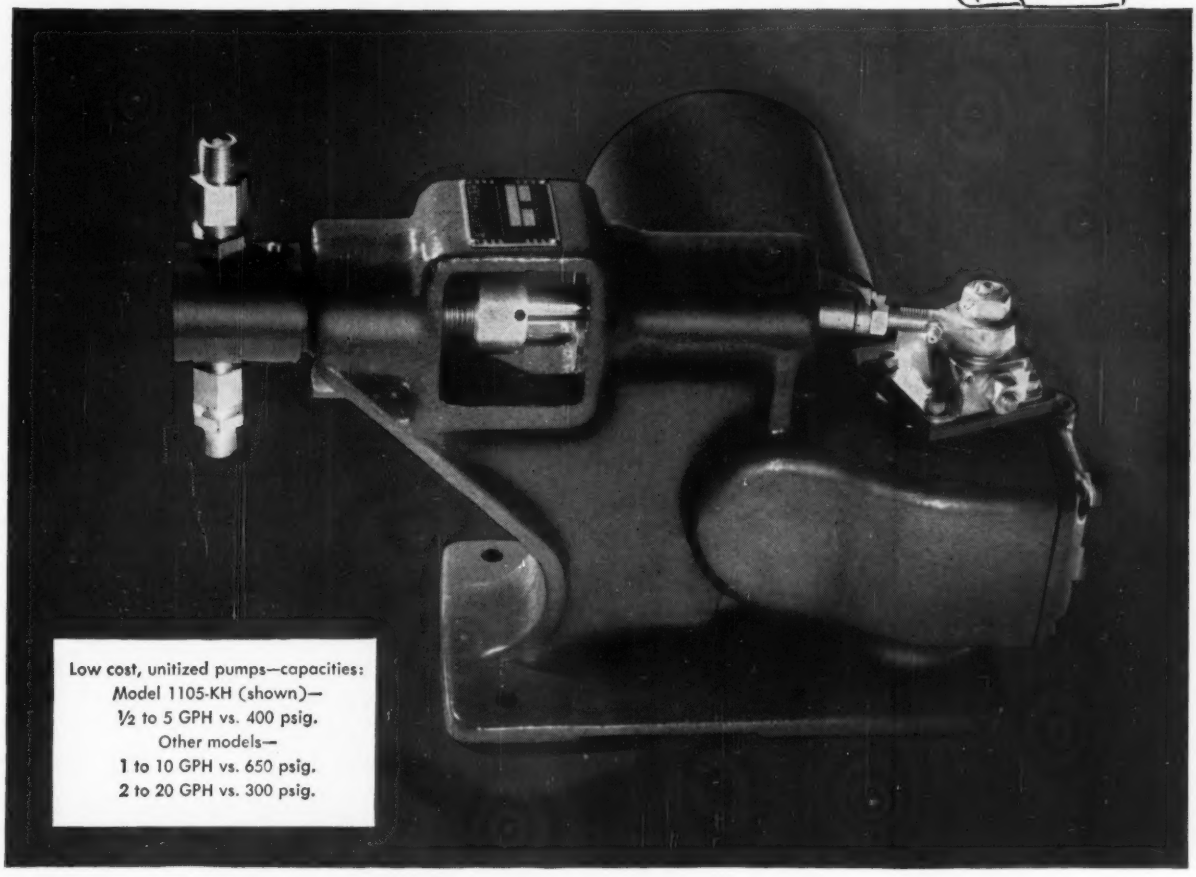

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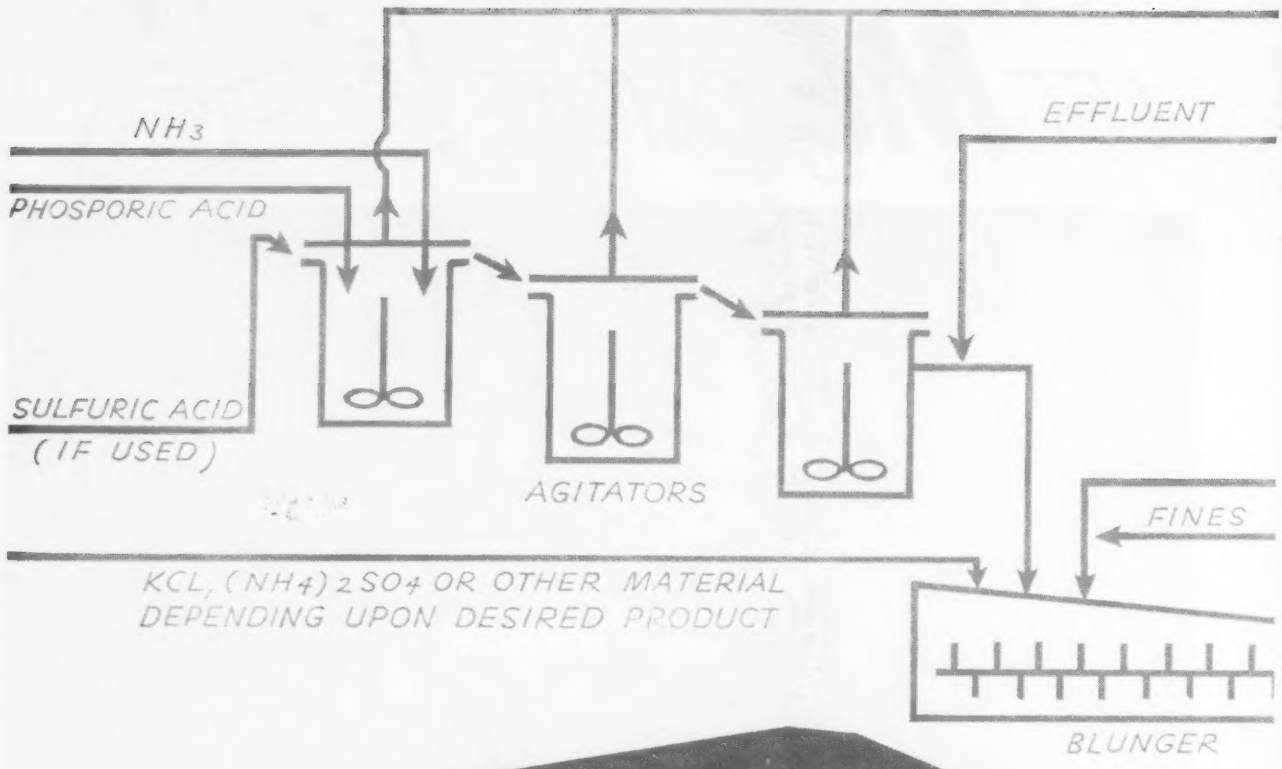

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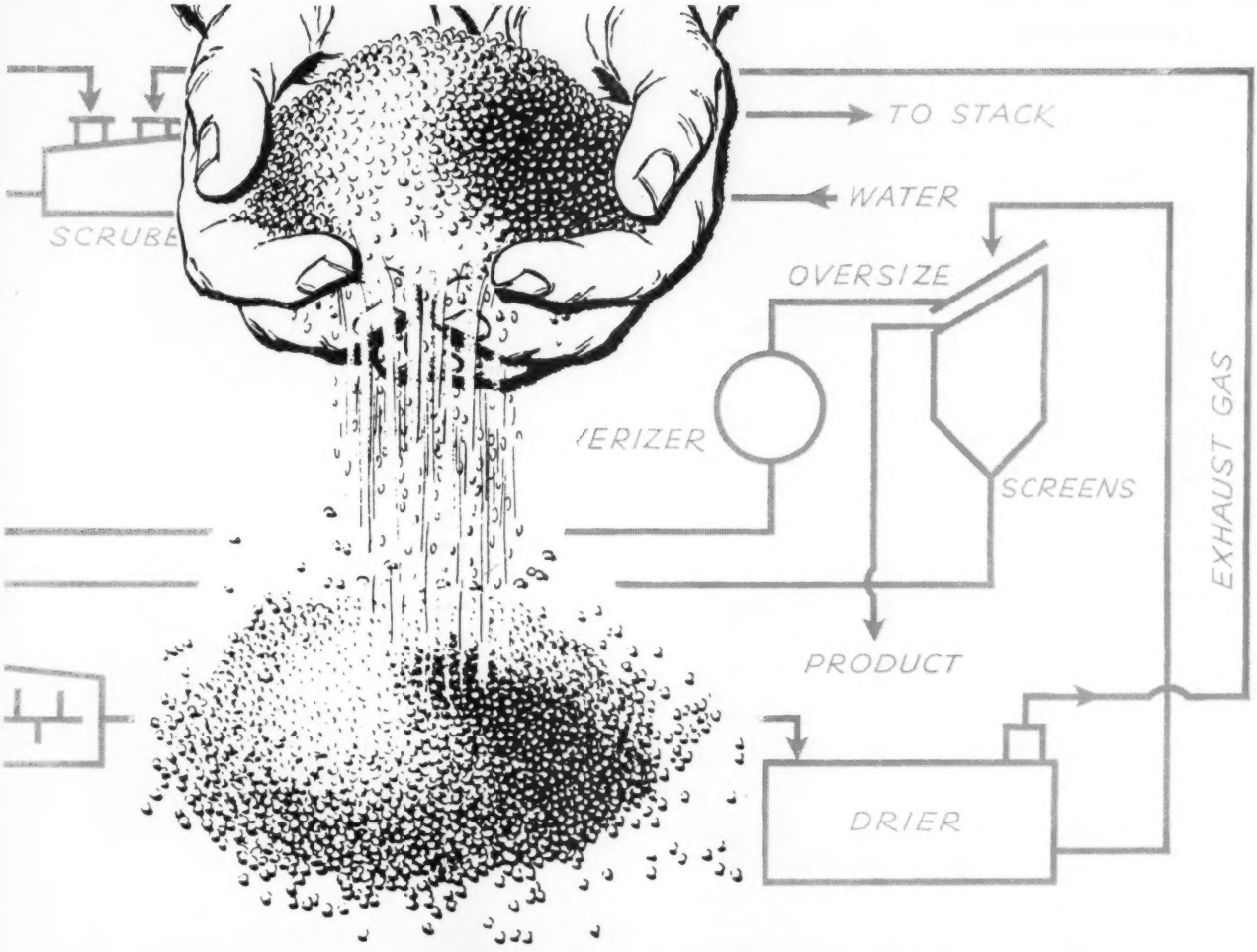
The Dorrco Diammonium Phosphate Process



Proved out at Missouri Farmers Association Granular Fertilizer Plant...

The first commercial production of diammonium phosphate based fertilizers took place last November at the new MFA Fertilizer Plant near Joplin, Missouri. Full design capacity of 200 TPD was reached less than three months later. An improvement in the Dorrco Granular Fertilizer Process, this new method can be readily adapted to existing plants.

The Dorrco Diammonium Phosphate Process can produce directly from 32% P_2O_5 acid a fertilizer analyzing approximately 18-48-0 (N-P_2O_5-K_2O basis). Iron, alumina and other elements go directly into the product where they assist granulation. The use of dilute phosphoric acid, purification by filtration and crystallization are all avoided. Final product is composed of closely sized, spherical, free flowing granules and size can be controlled over a wide range by proper selection of screens. The presence of a small percentage of monoammonium phosphate insures stability of the product.

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And transfer is so rapid—since there's no interfering air film—that the drying acts almost as if there were no falling-rate period.

There are some limitations to the new method: Material is heated slightly above the atmospheric boiling point of its moisture so heat sensitivity must be considered. The higher the latent heat of the liquid involved, the less thermal gain over air drying. Heating facilities cost more, though not enough to offset the lower dryer costs.

But on the plus side are: considerable overall savings in dryer costs and space requirements; big drop in heat requirement since no air is heated; suitability for solvent recovery operations and for many water-wet materials; and no dust losses.

Insight into uranium processing

Freer disclosure of atomic energy technology, notably exemplified by the just-completed Geneva conference, is extending into the raw materials. Latest to get out of the top-secret-only category is the $78 million AEC uranium-processing plant run by National Lead at Fernald, Ohio, since 1953.

Basically a chemical operation, this plant makes high-purity uranium metal from ore, then fabricates it into slugs for use in atomic reactors. Only other similar U. S. plant was built for the AEC in 1943 at St. Louis, Mo., and is operated by Mallinckrodt.

All possible process details are being released to *Chemical Engineering* for publication next month. In brief, though, the Fernald operation is this: crushed uranium ore and concentrates are digested in nitric acid. Resulting uranyl nitrate is extracted in a pulse column with a tributyl phosphate-kerosene solvent, stripped from the solvent with water and calcined to UO_3. Hydrogen reduces the trioxide to UO_2, which is then treated with HF to form UF_4. Metal is produced by reducing the fluoride in a bomb. It's melted, solidified into ingots and finally rolled into slugs.

Simpler way to ductile molybdenum

Starting with molybdenum trioxide and using a variation of the thermite process, the Bureau of Mines at Albany, Ore., has come up with a new process that makes low-oxygen, ductile molybdenum directly without going through the powdered metal as is now done commercially. Experimental work is far from over, but the Bureau is confident that its technically sound process will prove economically feasible.

Novelty of the technique is that it gives massive metal—not powder—that can be melted directly in a consumable arc furnace. Other methods now used produce powder that must be fabricated into electrodes before melting. And importantly, the Bureau's molybdenum is inherently ductile while the powder must be deoxidized to increase ductility.

In brief, equal amounts of reagent-grade molybdenum trioxide and nitrogen-free metallic calcium are mixed with a small quantity of iodine (which acts as a thermal booster) and charged to a reduction bomb. Reaction is initiated by a resistance igniter made of molybdenum wire; power is gradually increased until the wire melts and the charge ignites. Internal temperature is about 5,400 F.; pressure is 1,200 psi.

There are few impurities in the resulting molybdenum metal, which averages 70 ppm. oxygen, 150 ppm. nitrogen and 300 ppm. carbon.

Costs on the pilot-plant scale are high—$7.50 a lb., including labor, materials and equipment, as against the current selling price of $4.00 a lb. for the powdered metal. But this seemingly big difference is at least partly compensated for by the important fabricating advantages of the Bureau's metal. And if the process goes commercial, production costs should drop drastically.

Rare earths by ion exchange

Lindsay Chemical of West Chicago, Ill., is now running the first commercial unit for purifying crude rare earth fractions by ion exchange. Based on a process developed by F. H. Spedding and J. E. Powell of Iowa State College (which uses a citric acid solution of rare earths), Lindsay's technique gives greater purity—up to 99.99% if desired—and is faster than chemical processes.

The unit charges about 50 lb./day of crude fraction. Output, which is in the gram or milligram range, will include all the rare earths.

There's been interest in recent years in using ion exchange to split crude rare earth ore into its 15 components. But so far that's too slow and costly, so Lindsay will continue to use a chemical process for basic refining and concentrating.

Cut fertilizer costs by hydrolysis

A new use of hydrolysis may prove a boon to fertilizer users. Illinois Farm Supply Co., claiming big savings, has developed a way to hydrolyze water-insoluble calcium metaphosphate

(Continued on page 110)

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into either semigranular enriched superphosphates or granular mixed fertilizers of any composition.

Calcium metaphosphate is the cheapest and most concentrated form of phosphorus next to elemental. It's not hazardous so shipping costs are minimized. But until now it couldn't be incorporated chemically into mixed fertilizers.

Using hydrolysis, though, any standard fertilizer plant can make enriched super or high analysis mixed goods with few equipment changes.

For enriched super, the meta is mixed with rock phosphate dust, sulfuric acid and water, and the resulting product is bin- or pile-cured. Grades from 0-21-0 to 0-50-0 have been made, but emphasis will be in the middle of that range where savings are about 14¢ per unit of P_2O_5.

For mixed goods, sulfuric and water are mixed with the meta, then nitrogen and potash are added, and the product is dried and packaged. No curing is needed. In a typical high analysis mix (1-1-1 ratio), savings are 9¢/unit of plant food.

Only TVA makes meta now. (Phosphate rock enters the top of a furnace, phosphorus is burned at the bottom. Rising P_2O_5 converts the rock to a molten slag of meta.) Before IFS's hydrolysis can make much headway, more meta sources are needed. Several firms are studying the possibility, including Central Farmers Fertilizer Co., which would have to make elemental phosphorus and convert it to meta with phosphate rock deposits it owns in Idaho.

Another rubber plant sale looms

Long the white elephant of the government's synthetic rubber complex, the Institute, W. Va., GR-S plant is white no longer. Despite its awkard location and technological shortcomings, the huge 123,000-long-ton/yr. facility may be owned by a private concern come next February, even though it got no bids when the whole rubber complex was up for sale last year.

Revived interest in Institute is due to several factors: the excellent price received for the Baytown, Tex., GR-S plant in a previous postscript to the main sale; anxiety by West Virginia for new industry; present healthy rubber demand; and plans by interests in several nations to build their own GR-S production facilities.

While the first three of these are important to most prospective buyers, the fourth is vital to only one—Imperial Commodities Corp., California-incorporated offspring of large Dutch tobacco and natural rubber interests. This firm makes no secret of the fact it wants the plant to supply synthetic rubber needs overseas. By buying an already-built plant it can corner much of the market before competitors get onstream.

But it's highly problematical whether Congress would okay sale to such a company. Hence expectation is that Imperial will bid in partnership—perhaps with General Tire, Food Machinery, U. S. Rubber or Union Carbide. Other bidders might be Minnesota Mining, Edwin Pauley, Grace and—as individual bidders—Carbide and General Tire.

The price won't be low. Anybody expecting to get the plant at a bargain is fooling himself. The disposal commission has shown it drives a hard bargain, and if offers aren't sweet enough, might well recommend against any sale.

Mergers, mergers, mergers

Merging, though viewed somewhat less than benignly in Washington, is more and more becoming a favorite process industry sport. Last month three more big combines were revealed.

Biggest and first of its kind is the merger of Lion Oil into Monsanto. Never before has a major chemical maker absorbed a big oil company. On the basis of giving 1½ shares of its $2 par common stock for each Lion share outstanding, Monsanto will pay about $210 million for its new division if stockholders approve the move.

Significantly, Lion is more than an oil company. About 40% of its near-$100 million sales—and more than half of its investments and earnings—come from chemicals, mostly ammonia and its derivatives. Monsanto, a big ammonia user, thus gets double advantages: a new source of raw materials and a foothold in the oil business.

In a different field, Olin Mathieson, one of the merginest firms in industry, has more than doubled its timber resources by buying Brown Paper Mill Co. of West Monroe, La. O-M, which just completed its acquisition of Blockson Chemical, paid about $90 million for Brown.

Possibly paving the way for still another Olin merger is a new joint program of applied research in supersonic aircraft and missile propulsion by Olin, Marquardt Aircraft of Van Nuys, Calif., and Reaction Motors of Danville, N. J. Olin has had a big interest in both firms for the past year.

Rounding out the current merger list, which as you read this has probably already grown, is a proposed compact between International Cellucotton Products (makers of Kleenex), Chicago, and Kimberly-Clark Corp. of Neenah, Wis. It looks certain to go through.

For more of WHAT'S HAPPENING 112

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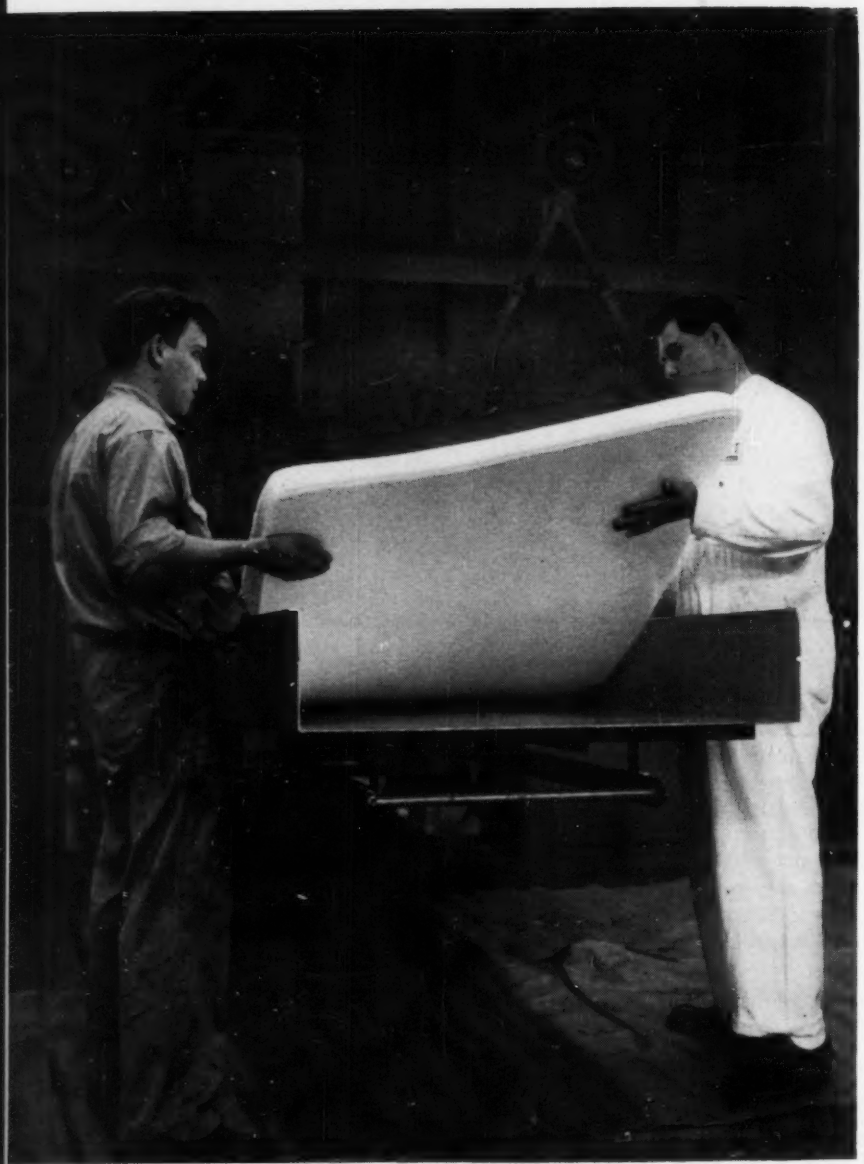
SEPTEMBER
1955

What's Happening

Polyurethanes: Latest Chemical Bonanza



Development as foams has opened the door to other possible applications for polyurethanes in adhesives, fibers, paints, rubbers.

Generating an enthusiasm which, some say, hasn't been seen since the discovery of nylon, is a new group of synthetic polymers—polyurethanes—made by reacting isocyanates with polyester resins.

And no wonder. Already vying with foam rubber both here and abroad are polyurethane foams. These foams, either flexible or rigid, are claimed to be not only lighter and stronger than foam rubber, but resistant to oil, dirt, dry-cleaning solvents. They can be made in a variety of densities under simple procedures; won't rot, age or tear; have excellent insulating and electrical properties; can be dyed, sewed, glued, cut into any desired shape.

With this list of credits, they're finding application in everything from life preservers to linings for clothing, mattresses to machinery insulation and sponges to seat cushions.

But that's not all. Up-and-coming polyurethane products include adhesives, wire coatings, paints, fibers and urethane rubber tire

in Chemical Engineering

treads which will last the full life of a car.*

▶**Who's Involved?**—Heading the list of domestic producers of polyurethane chemicals today are Du Pont and Mobay. The latter firm, formed last year, is a jointly owned corporation of Monsanto Chemical Co. and Farbenfabriken Bayer A. G. (Leverkusen, Germany).

And taking advantage of their lead in the field, both firms are stepping up production of raw materials (foaming and formulation is left to licensees):

• Mobay, says President David L. Eynon, expects to start full-scale production of isocyanates and polyester resins next month at its new plant near New Martinsville, W. Va. Estimated monthly capacity will be "several hundred tons" of isocyanates and equivalent amounts of polyesters. Until the new plant is ready, Mobay is supplying chemicals from an interim plant at Anniston, Ala.

• Du Pont plans to complete additional facilities for isocyanate manufacture at its Deepwater, N. J., plant by mid-1956, but won't reveal anticipated capacity. Toluene diisocyanate (TDI) will be the major product produced.

Other isocyanate programs under way include:

• National Aniline's multimillion-dollar polyisocyanate plant now under construction at Moundsville, W. Va. All raw materials supplied to the new unit will come from within the Allied Chemical and Dye parent corporation. High on the list of products to be made are the diisocyanates of toluene (TDI), ditolyl (TODI) and diphenylmethane (MDI).

• B. F. Goodrich's small commercial plant at Shelton, Conn., expected to be in production next month.

• Carwin Co.'s interim plant at North Haven, Conn., already supplying truckload quantities of ditolyl isocyanate (TODI) and dianisidine isocyanate (DADI).

• Westvaco's (chlor-alkali division) small plant at Charleston, W. Va., supplying drum lots of toluene diisocyanates.

Suppliers of polyesters include Mobay, National Aniline, Rohm & Haas, Pittsburgh Plate Glass and Morton-Wither Chemical Co. (Greensboro, N. C.). Du Pont is not supplying polyesters, deciding not to compete with customers who buy its adipic acid, a basic ingredient of the polyesters.

▶**Processors Expand**—Keeping up with expanding raw materials facilities are a number of foam-making firms, among them Nopco Chemical Co. and American Collo Corp. (Ridgefield, N. J.).

Nopco, licensed by Lockheed, Mobay and Du Pont, will put two new plants on stream by October—one, near Irvington, N. J.; the other in Los Angeles. A third unit is due to go up in the Midwest sometime next year. All three units will produce polyurethane foams as well as polyvinyl foams.

American Collo also has its eye on several Midwest and West Coast sites for new plants to be erected in the near future. Meanwhile, the company has joined with Robinson Cotton Mills Ltd., to form Robinson Collo Canada Ltd. The joint enterprise, due to get into production this fall, will manufacture Collo Allfoam at Woodbridge, Ont.

An interesting sidelight to American Collo's operation is the fact that, though licensed by Mobay, it doesn't as yet enjoy any of the benefits, other than raw materials, offered to licensees.

Instead, says Rolf Moroni, vice president of the company and head of its German parent, Collo Rheincollodium (Cologne), Collo is "years ahead" of its U. S. competitors because it uses foaming machines and methods tested in Germany.

▶**Are They New?**—Basic research and development on polyurethane chemicals was started almost simultaneously in the 1930's by Du Pont and part of the I. G. Farben chemical empire. Since World War II, Monsanto, Farbenfabriken Bayer A. G. (successor to I. G. Farben), Lockheed and Goodyear have entered the field.

With so many firms getting into

* Urethane rubbers have been commercially produced in Europe under the Bayer trade name, Vulcollan. In the U. S., both Du Pont and Goodyear have made urethane rubbers. Du Pont's Adiprene B is being field-tested; Goodyear's Chemigum SL is in the pilot-plant stage.

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TOYS FOR KIDS: part of the vast potential market for urethane flexible foams.

the act, it's not surprising that polyurethanes are not exclusively controlled by any one company. Rather, they are licensed by those holding important patents–e.g., Mobay, Du Pont, etc.

▶ **Polyurethane Chemistry**–Polyurethanes embrace a wide variety of compounds having an -NHCOO- or urethane linkage. Key components of these chemicals are the isocyanates and polyesters.

When these react, the active hydrogen of the polyester hooks on to the nitrogen of the isocyanate molecule; the rest of the ester molecule links up with the carbon in the isocyanate group.

Typical starting materials are tolylene diisocyanate, derived from toluene by a series of reactions (nitration, reduction, phosgenation) and the polyester resulting from the reaction of adipic acid and ethylene glycol.

The addition of water or carboxylic acids to this mixture results in the generation of CO_2, leading to the formation of polyurethane foams. Water has the edge over the acids because it's cheaper and doesn't involve complicated, simultaneous side reactions.

Rounding out the list of essentials for foam production are catalysts and emulsifiers–added to control the rate of foaming and cell structure of the foam.

Joseph Winkler, research director for American Collo, likens the catalyst (often a tertiary amine or alkali phenate) to the triggering mechanism for an atomic or chain reaction. It acts, he says, as a policeman directing the course of the reaction.

▶ **Made in Minutes**–A typical foam formulation outlined by Mobay consists of 35-40 parts isocyanate; 100 parts polyester; 7-8 parts water, catalyst, dye and surfactant (1/10 part surfactant gives pore size control).

These materials, at temperatures below 25 C., are carefully metered, then fed into a mixing head which moves back and forth across an open mold traveling beneath it.

As soon as the reaction mixture hits the mold, foaming starts. Molds are waxed to permit removal of foam which would otherwise adhere permanently to them.

Complete conversion of reactants to foam takes less than four minutes. The product can be soft or rigid, with a wide density range (1.5-6 lb. per cu. ft.). It maintains its properties over a wide temperature range, −20 to 175 F.; will stiffen, but won't break, at −70 F.

▶ **Work Continuing**–Despite the apparent ease with which polyurethane foams are made, refinements in processing are still being uncovered.

One of these, scrap regeneration, is the subject of one of American Collo's numerous pending patents. (Unlike polyethylene, which is thermoplastic, polyurethane foam is thermosetting.) In general, it consists of "solubilizing" the scrap –i.e., splitting the long-chain polyurethane molecule (molecular weight about 200,000) into shorter polymeric chains (molecular weight about 2,000) which can be reused in foam preparation.

▶ **Costs Dropping**–The number one commercial polyurethane, foam, is competitive with foam rubber on a volume for volume basis, but more expensive on a weight for weight basis. And the new, but as yet unmarketed, polyurethanes–adhesives, paints, etc.–will most probably be higher priced than their competitors. But people in the field anticipate a drop in price when the cost of isocyanates goes down.

That this is already happening is evidenced by the fact that tolylene diisocyanate, selling for $1.40 per lb. several months ago, now costs $1.20 per lb. Another 20¢ drop is predicted once the big new plants are on stream and in full production.

One thing seems certain. With all they have to offer, polyurethanes are here to stay.

Two Expansions to Net 49 Million Lb. of PE

The two biggest producers of pentaerythritol, Heyden Chemical Corp. and Hercules Powder Co., have both decided to expand in a big way.

First to reveal definite plans was Heyden, which will build a $4 million plant (no location specified) with an annual PE capacity of 25 million lb. It will be the company's fourth such plant and is

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expected to be in production by the end of 1956.

Probably just before the Heyden plant starts up, Hercules will bring a $6 million PE plant on stream at Louisiana, Mo. Capacity will be 24 million lb. of PE and 100 million lb. of formaldehyde, the basic raw material for PE. The plant is on the site of an existing Hercules anhydrous ammonia plant, which will continue to produce at the current rate of 40,000 tons annually. Some of the existing equipment at the plant, which used to be the government's Missouri Ordnance Works, will be used for formaldehyde-PE production.

Another Oil-From-Coal Plant Is Being Studied

One American firm and two German companies have been asked to submit project reports to India's Production Ministry on a synthetic oil plant for India. If built, the facilities would cost over $100 million and would produce 300,000 tons of oil products annually.

Involved are M. W. Kellogg Co. of New York, which is building the Sasol oil-from-coal plant in South Africa, Lurgi of Frankfurt and Heinrich Koppers of Essen, Germany.

Big Data Reduction System for Canada

The world's largest industrial data reduction system—a $50,000 automatic logger being built by Fischer & Porter Co., Hatboro, Pa. —will be installed in the 20,000 bpd. refinery of Canadian Petrofina, Ltd., soon to start up near Montreal. The logger will automatically monitor, analyze and record a total of 480 process variables for all nine process units at the refinery.

According to Fischer & Porter, the data reduction system will completely eliminate routine checking by control personnel and will guarantee accurate records even during times of unit upsets.

Under normal conditions the system will automatically type a single log sheet of all variables every hour on the hour. Between loggings, it will scan all variables, reporting only selected or abnormal conditions. In case of unit trouble, the logger signals with an alarm and immediately types the out-of-line condition and its location. Besides raw data, the system will compute and record such items as total flow, efficiency ratios and yield factors.

Alum Plants: One Planned, One Finished

By early this fall General Chemical Div. of Allied Chemical will have 23 aluminum sulfate (alum) plants around the country. Just completed is a major addition to General's plant at Kennewick, Wash. And due to go on stream late this summer is a new plant at Tacoma, Wash., the first in the Puget Sound area.

Output from the expanded unit at Kennewick goes primarily to Atomic Energy Commission installation at Hanford, Wash. Production at Tacoma is destined for pulp and paper mills near Puget Sound.

No Silicate Scale With New Peroxide Bleaching

By stabilizing its hydrogen peroxide bath and making it alkaline with phosphates and other non-scale-forming chemicals, Becco Chemical, a division of Food Machinery and Chemical Corp., has achieved a continuous textile bleaching process that eliminates formation of silicate scale in the equipment.

The new process has secretly been in successful commercial operation in one of the largest U. S. bleacheries for over a year.

Silicate scale is a problem because it abrades the cloth, making it hard to dye and finish. Previously, frequent equipment shutdown was needed to remove scale either by caustic boiling or buffing with a silicate cutting compound.

Convention Calendar

Production Engineering Show, Navy Pier, Chicago, Sept. 6-17.

Second Western Area Development Conference, "Industry Looks to the Future," Multnomah Hotel, Portland, Ore., Sept. 8-9.

American Institute of Electrical Engineers, 2nd "Electrical Conference of the Petroleum Industry," Hilton-Shamrock Hotel, Houston, Sept. 12-14.

Instrument Society of America, 10th annual conference and exhibit, "Instrumentation Paces Automation," Shrine Exposition Hall and Auditorium, Los Angeles, Sept. 12-16.

Chemical Institute of Canada, corrosion symposium, Sheraton-Mount Royal Hotel, Montreal, Sept. 15-16.

Society of Industrial Packaging and Materials Handling Engineers, 10th annual exposition, Kingsbridge Armory, New York City, Sept. 20-22.

Chemical Market Research Assn., "Management Looks at Consumer Products," The Cavalier, Virginia Beach, Va., Sept. 22-23.

American Assn. of Textile Chemists and Colorists, annual exhibition, Chalfonte-Haddon Hall, Atlantic City, N. J., Sept. 22-24.

Drug, Chemical and Allied Trades Section of New York Board of Trade, 65th annual meeting, Pocono Manor Inn, Pocono Manor, Pa., Sept. 22-25.

American Institute of Chemical Engineers, "Atoms for Profit" and "Growth of the Oil and Chemical Industry by Integration," Lake Placid Club, Lake Placid, N. Y., Sept. 25-28.

Atomic Industrial Forum, 1st trade fair, Sheraton-Park Hotel, Washington, D. C., Sept. 26-30.

World Plastics Fair and Trade Exposition, National Guard Armory, Los Angeles, Oct. 5-9.

American Society of Lubrication Engineers and American Society of Mechanical Engineers, 2nd annual lubrication conference, Antlers Hotel, Indianapolis, Ind., Oct. 10-12.

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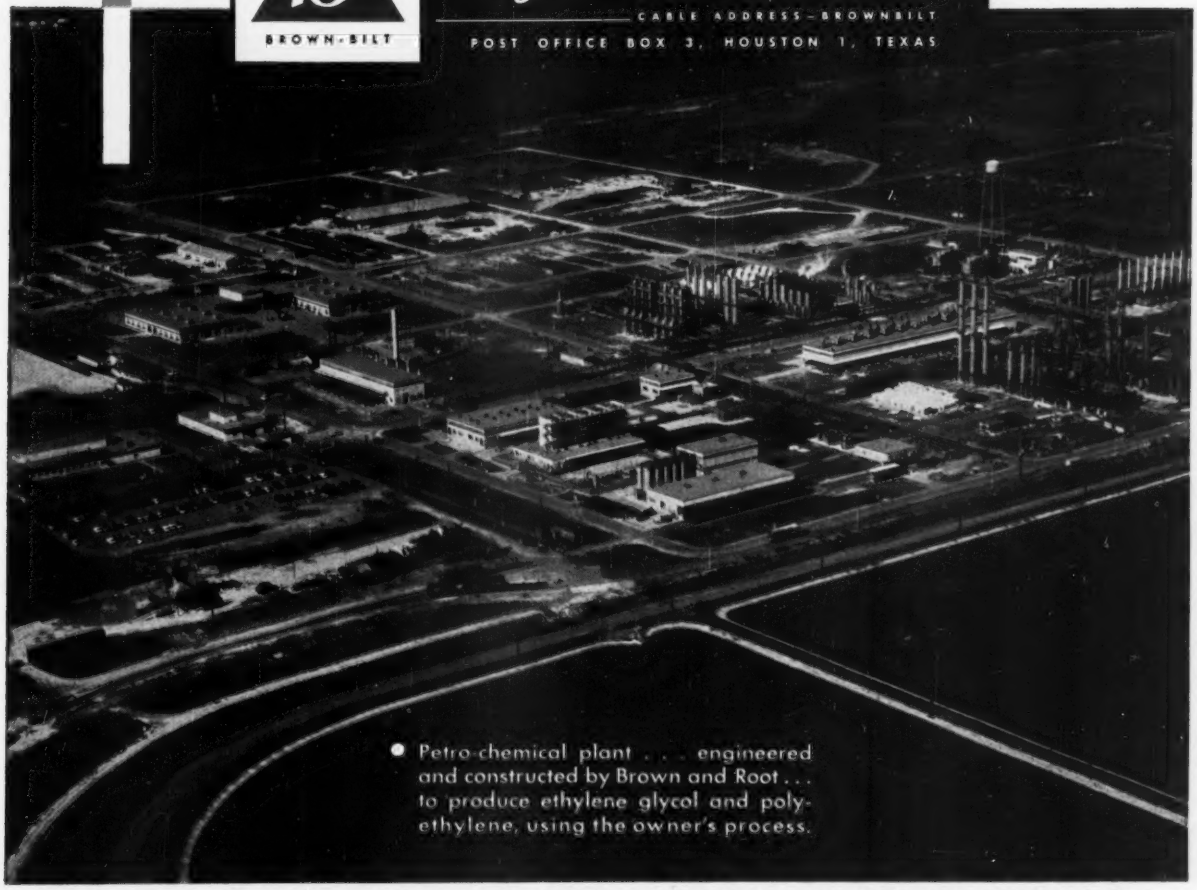

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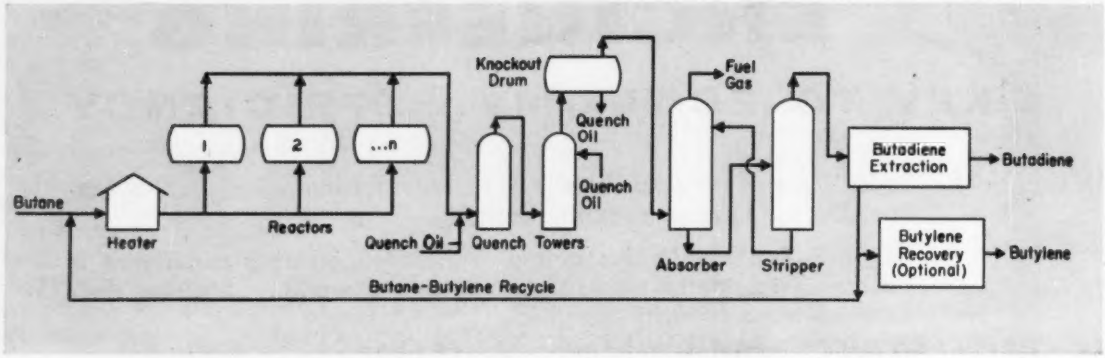

Make Butadiene Directly From Butane

Low capital and operating costs, high conversion are big advantages of this one-step catalytic dehydrogenation process. Now two big new units are planned.

Completing a cycle in rubber, Germany, the country that gave us Buna (GR-S) rubber, will soon be using a U. S. process to make butadiene for its expanding synthetic rubber needs. And the same method is about to get its second U. S. use.

The process is Houdry Process Corp.'s single-step dehydrogenation of normal butane to butadiene. Chemische Werke Huels will use it in a big new plant—36,000 metric tons/yr.—at Marl, West Germany. It will be the world's second such plant, Europe's first.

Expected availability of butane in West Germany from growing refinery operations making high-octane gasoline was a prime factor in picking the Houdry technique, says Dr. Paul Baumann, managing director of Huels. In all, eight different butadiene processes were studied.

Present German butadiene supply comes from acetylene. West Germany needs about 60,000 tons a yr. of synthetic rubber to satisfy foreseeable markets.

▶ **Commercially Proved**—Only industrial application of Houdry's process now operating is an 18,000-ton/yr. unit at El Segundo, Calif. (photo, p. 120). Originally financed by the government and just recently sold to its operator, Standard Oil of California, it has been in almost continuous operation since 1944.

First production was butadiene alone, with no other C_4 hydrocarbons. After World War II, though, emphasis was switched—with very few equipment changes—to production of both butadiene and butylene.

▶ **Another Planned**—All other U. S. butadiene plants use butylene or ethyl alcohol, rather than butane, as the raw material. However, for more than a year, Texas Butadiene and Chemical Corp., a new company, has been trying to get started on a plant that would incorporate the Houdry process, and it now looks like this project will go through (see *Chem. Eng.*, July 1954, p. 108).

Latest word is that financing is complete, with equity capital set to come from Godfrey L. Cabot, Inc., Boston carbon black maker and largest stockholder in the venture, and Carl M. Loeb, Rhoades & Co., New York investment bankers. Also, the Armed Services Petroleum Purchasing Agency has awarded the firm a facilities contract for aviation gasoline that can be coproduced and the Office of Defense Mobilization has issued a certificate of necessity for fast tax writeoff.

Plans by Texas Butadiene call for a $26 million unit to be built by Fluor Corp. near Houston, Tex., that will have annual capacities by early 1957 ranging from 17,000 tons of butadiene and 2.5 million bbl. of avgas (from coproduced butylenes), through increasing amounts of butadiene and decreasing quantities of avgas to 43,000 tons of butadiene alone. This flexibility in operating possibilities is one of the important features of the Houdry process.

▶ **High Heat, Low Pressure**—Houdry's flow pattern is not complicated (see *flowsheet*). Fresh feed (mostly *n*-butane) and butane-butylene recycle are preheated to about 1,150 F. and enter the fixed bed reactors—horizontal steel shells lined with ceramic tile. Reaction takes place over a chromia-alumina catalyst at an average temperature of 1,125 F. and at a pressure of 6 in. Hg abs:* The reactors, which operate in cycles, have average on-stream times of 8-10 minutes.

Reactor effluent is cooled in two quench towers in series by direct contact with circulating quench oil. The product stream

* If primarily butylenes are wanted, with little butadiene, the process is run at about 5 psig.

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COMPLETE LINE—TOTALLY-PROTECTED A-C. MOTORS

Reliance is pleased to announce the immediate availability of a complete line of Reliance Totally-Protected A-c. Motors in the new NEMA frames 182-326U. B-1500

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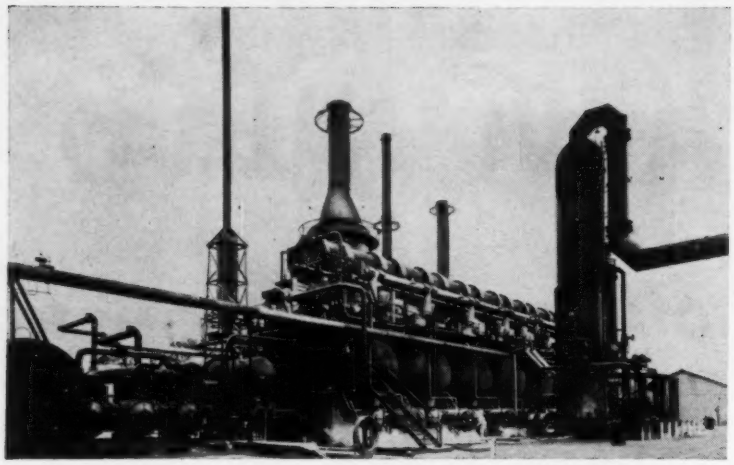


ONLY USE of Houdry's process is by Standard Oil of Calif. at El Segundo.

next goes to a knockout drum. Overhead is compressed in four stages and passes to a conventional absorber and stripper for recovery of C_4 and heavier material.

The final step is separation and purification of butadiene by either furfural extraction or liquid-phase cuprous ammonium acetate extraction. If butylene coproduct is desired it can be separated from the recycle stream.

The on-stream period of the reactor cycle is followed by a vacuum purge to remove hydrocarbons. Then catalyst is regenerated in place with air that's preheated by direct fuel combustion in the air stream. After regeneration, the reactor is purged with steam ejectors. Thus in the seven reactor group tentatively planned for the new Huels plant, three will receive feed, while three receive air and the seventh undergoes valve changes and purging.

▶ **Heat Conserved**—Operating conditions in the Houdry process are chosen to give essentially adiabatic operation. Heat required for reaction is essentially the same as that supplied by combustion of the coke deposits during catalyst regeneration.

To maintain the desired heat capacity of the catalyst bed, a catalytically inert material with high heat capacity—usually about 40% of fused alumina—is mixed with the pelleted catalyst. The inerts act as a heat-storage medium, absorbing heat during regeneration, then releasing it to the reactants during dehydrogenation.

This system, combined with short on-stream periods in the reactor cycle, keeps temperature variation throughout the cycle down to 50 F. and provides the optimum temperature range for high conversion. Total coke deposit is thus kept low and catalyst activity high.

▶ **Some Imbalance**—In actual operations, endothermic heat of reaction is usually slightly greater than the exothermic heat of combustion. This heat deficiency is controlled by adjusting reactant and air temperatures and by using considerable excess air in regeneration. The latter equalizes small temperature differences in the large—1,400 cu. ft.—catalyst bed.

▶ **Lower Investment**—Capital costs are minimized in two major areas by the Houdry process. Expensive alloy heat exchangers within the reactors are unnecessary; and no expensive feed preparation towers are needed if normal butane is available. In the more widely used processes that start with butylene as the main reactant, close purification of refinery butane-butylene streams must be effected by extractive distillation and selective polymerization.

Houdry also cites these advantages for its process: Reactants enter at reaction temperature, minimizing premature cracking. The temperature range is narrow to protect catalyst life. High conversion per pass and high product concentration are achieved. No hot gas circulation is required for regeneration because fresh air is used.

Wood Pulp Converted To Cellulose Caprate

Degraded wood pulp is the primary raw material at a new cellulose caprate plant designed and built by the research department of Imperial Chemical Industries, Nobel Division, Steventon, Scotland.

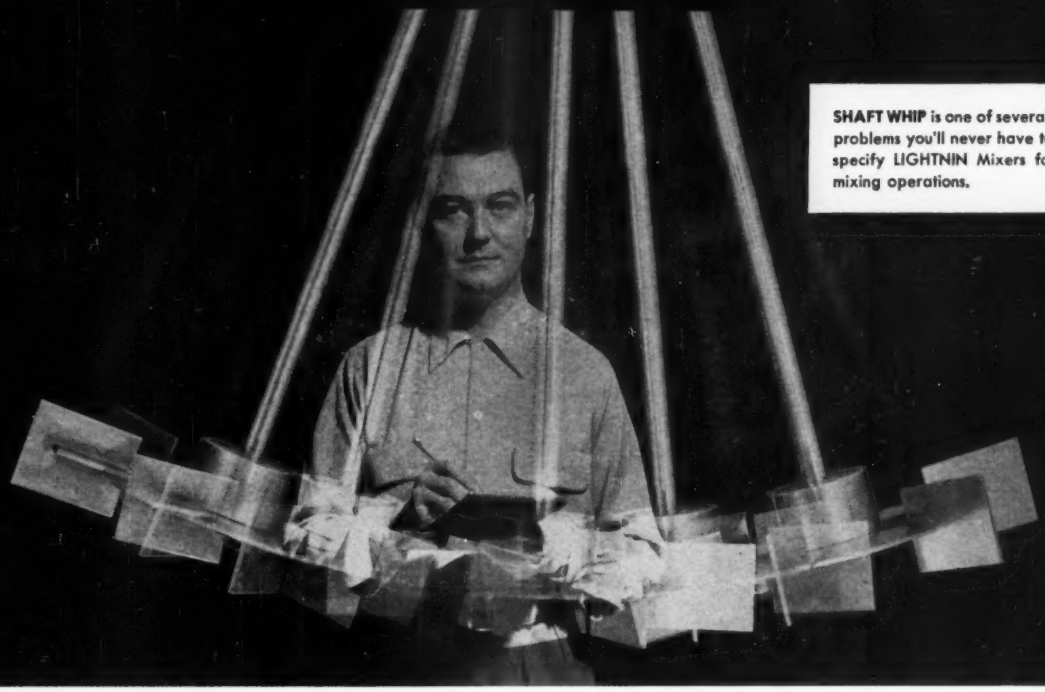
Used for optical lenses in aircraft, the caprate comes from the wood pulp via the following route: Activated by monochloracetic acid in a specially designed chemical stoneware mixer, the cellulose is esterified at constant temperature in a pot containing capric anhydride, capric acid and perchloric acid. After 24-30 hours, a homogeneous solution is filtered. Cellulose caprate is precipitated from the filtered solution with methanol.

Purified by washing, the cellulose caprate is collected in a glass filter column by vacuum, dried to a powder and extruded into sticks.

Design Innovations To Raise Ammonia Yield

Some extra efficiencies are predicted for a 300-ton-per-day anhydrous ammonia plant now under construction for Standard Oil of California at Richmond, Calif. M. W. Kellogg is building the plant to use its steam-methane reforming process in which natural gas and refinery gas are starting materials.

A special quench-type reactor that allows optimum temperature control will improve ammonia yields and lower operating costs. Near-isothermal conditions in the reactor will lead to longer catalyst life, lower maintenance costs, and higher conversion per pass. Unique to the process is the reforming step which results in 25-35% savings in compressor horsepower.



SHAFT WHIP is one of several engineering problems you'll never have to face if you specify LIGHTNIN Mixers for your fluid mixing operations.

How to control **shaft whip** *when you mix fluids*

This is a picture of how *not* to mix fluids.

You know the phenomenon. A three-inch steel shaft, suspended from a rigid mount, is rotating at a speed close to its natural vibration frequency. Without warning, the shaft begins to whip back and forth like a pendulum—farther and farther, faster and faster—until it snaps.

If this happens inside one of your tanks, you're in for a costly repair bill.

It *can't* happen when you mix with LIGHTNIN Mixers.

How to beat shaft whip

We've tortured hundreds of perfectly good mixer shafts in our lab, just to make sure *you'll* never break one. Our engineers know just how fast a shaft and impeller can rotate, in liquid or in air, without getting too close to the "critical speed." That goes for shafts of any material, any diameter, any length.

How else does this give you better mixing? Well, if you can use a long overhung shaft in a tank, without having to steady it at the bottom, you avoid the upkeep and operating problems of a steady bearing. That can be a big item if you're mixing corrosives or abrasives.

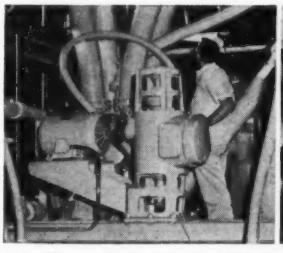
Then, too, if you're using a rotary mechanical seal on a closed tank, you'll want the shaft to run true at all times, to minimize wear on the seal faces.

Here's why you save

We can tell you just how long a shaft, of any diameter, you can use without going to a steady bearing; or conversely, what diameter a shaft of given length should have if you want to keep runout within well-defined safe operating limits.

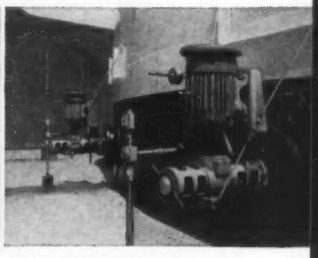
This is just one reason why you save time and cost by mixing with LIGHTNINS. You avoid risk, too. Every LIGHTNIN Mixer is unconditionally guaranteed to do the job for which it is recommended.

Why not find out, today, how easy it is to get the fluid mixing results you want? Just call your LIGHTNIN representative (listed in Chemical Engineering Catalog). Or write us for specific information that will help you.



HANDLE ALMOST ANY fluid mixing job with these versatile Series "E" LIGHTNIN Mixers. You can get them in sizes from 1 to 500 HP; for open or closed tanks, top or bottom entering; in hundreds of power-speed combinations.

MAKE ANY OPEN TANK an efficient mixing vessel, by adding a LIGHTNIN Portable Mixer. Thousands in use, many for 20 years and more. Thirty models, ⅛ to 3 HP.



IN LARGE TANKS (up to 6 million gallons) you can mix, blend, circulate, suspend solids efficiently with LIGHTNIN Side Entering Mixers. No shutdowns are ever necessary to repack stuffing box or replace mechanical seal. Sizes 1 to 25 HP.

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Get these helpful facts on mixing: cost-cutting ideas on mixer selection; best type of vessel; installation and operating hints; full description of LIGHTNIN Mixers. Free—no obligation. Just check data you want, tear out and mail to us today with your name and company address.

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- ☐ B-102 Top Entering Mixers (turbine and paddle types)
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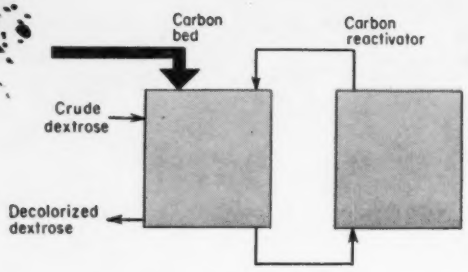

Activated Carbon . . . Takes Over for Bone Char

A bone char stronghold—dextrose refining—falls as granular activated carbon's 16-fold greater adsorptive capacity leads to thriftier operation.

Complete now is Corn Products Refining Co.'s switch from bone char to granular activated carbon for decolorization of dextrose liquors at its Pekin, Ill., plant. Results to date have been so encouraging that CP expects to swing soon to granular carbon at two other plants at North Kansas City, Mo., and Argo, Ill.

Conversion of these two units would mean that perhaps 85% of domestic dextrose refining capacity uses activated granular carbon as the chief decolorization agent.*

Granular carbon performance to date at Pekin points to better than a 16-fold increase in capacity, on a pound-for-pound basis, for sugar decolorization, and longer operating cycles before carbon needs regeneration. Corn Products reports only 5-6 lb. of new type carbon is involved in production of a 100-lb. bag of dextrose; 100 lb. of bone char was required before. There are space savings, too, for one bed of carbon now handles same volume of 28° Be. dextrose liquor as did four beds of bone char.

Credit part of the capacity increase to the 87-89% carbon content of PCC (Pittsburgh Coke & Chemical Co.) Type SG granular activated carbon, as contrasted with bone char's 7-15% C content.

Higher porosity and smaller particle size also help PCC carbon's activity, providing a surface area of about 1,000 sq. meters per gm. vs. 50-120 sq. meters per gm. for bone char.

▶ **Lower Over-All Cost**—Activated carbon's higher adsorptive capacity makes for extra-long cycles between regenerations; these, in turn, mean lower over-all losses (and cost) of decolorizer per unit of dextrose liquor treated.

This despite PCC carbon's higher price per pound than that for bone char (27¢ vs. 12¢) and higher makeup required per cycle (decolorization plus regeneration). PCC carbon losses, due to abrasion and burning during reactivation, are about 5% per cycle compared to a loss, in good bone char practice, of only 0.3-0.5%.

Another factor adding to activated granular carbon's ultimate economy: Pittsburgh Coke claims it can be completely reactivated time and time again. Bone char, on the other hand, loses effectiveness with repeated regeneration.

▶ **Extra Efficiency**—Spicing the increased capacity is added efficiency. The granular activated carbon removes not only existing color bodies but color precursors as well (such as hydroxymethyl furfural) which tend to form color during later processing or decrease shelf life. Corn Products no longer feels it necessary to give dextrose liquors a final polishing with vegetable carbon.

▶ **More to the Story**—Changeover to granular activated carbon for dextrose refining at Pekin meant more than simply inserting a new material into the process stream. To exploit the carbon's superior properties Corn Products needed new equipment: namely, two seven-hearth Herreshoff furnaces to regenerate the spent carbon. Old vertical tube type kilns used for bone char reactivation couldn't be run hot enough (1,800 F.) to do the job.

That the furnace change was made, in the face of an expenditure of $97,000 only a year earlier on new gas and oil burners for

* Clinton Foods, Inc., of Clinton, Iowa, second only to Corn Products in dextrose production, converted to the same granular carbon a few years ago.

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You Can See Why

SARAN LINED PIPE

CUTS CORROSION COSTS

Corrosion resistant Saran Pipe swaged into steel is your answer to downtime losses.

Saran lined pipe, fittings and valves are built to convey acids, alkalies and other corrosive liquids at low over-all costs. The durable inner lining eliminates shutdowns due to corrosion and forms snug, tight-fitting joints that prevent leakage.

Saran lined pipes, fittings, and valves are easily and inexpensively installed. They are cut and threaded in the field with any standard pipe fitter's tools. Because of saran lined pipe's rigidity, even long spans require a minimum of support.

If your operation requires the conveying of corrosive liquids, and if downtime losses are troubling you, investigate saran lined pipe, fittings, and valves today. For further information, contact the Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale 20, Mich., Dept. 526A-2.

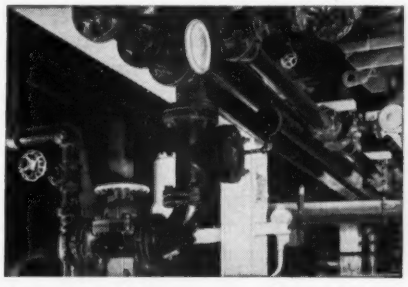
RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

SOME OF THE MANY INSTALLATIONS USING

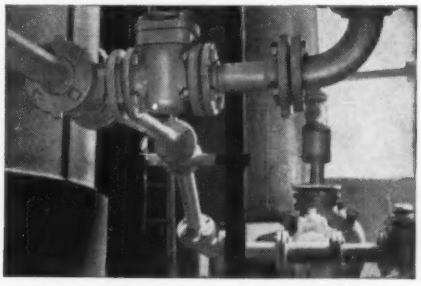
SARAN LINED

STEEL PIPE

Saran Lined Pipe is Manufactured by The Dow Chemical Company Midland, Michigan

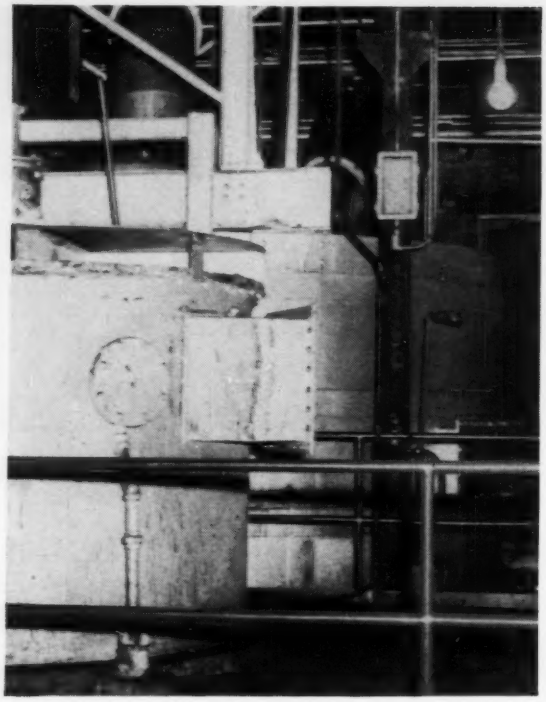


A large chemical company uses this installation to convey demineralized water. It has a perfect record of keeping the water free of contamination for five years!

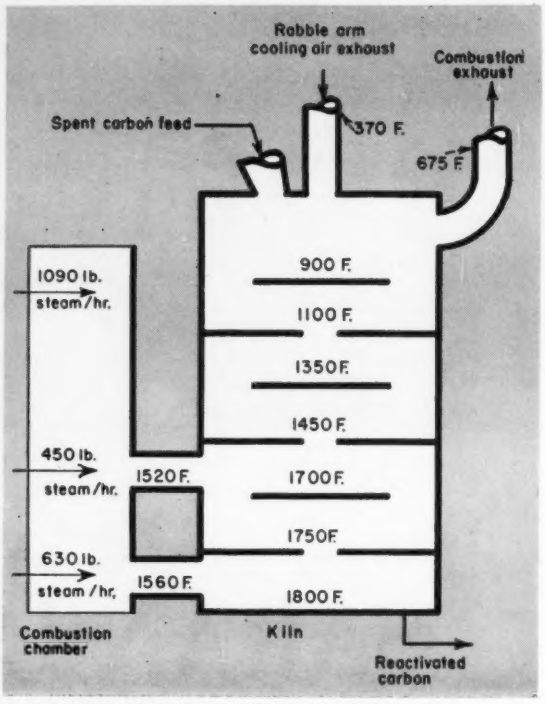


Saran lined pipe used for conveying hydrochloric acid at temperatures from 20° to 90°C., has had no unscheduled interruptions due to corrosion for over two years!

you can depend on DOW PLASTICS DOW



HERRESHOFF KILN reactivates spent carbon in . . .



SEVEN HEARTHS with high heat, sensitive control.

the old kilns and a $150,000-200,000 price tab* for each Herreshoff (plus accessories) installed, is tribute to the virtues of both the material and the equipment.

Each of the kilns at the Pekin plant can reactivate about 50,000 lb. of PCC SG carbon per day. Fuel consumption is about 4,250,000 Btu. per hr., less 1,250,000 Btu. per hr. returned to boiler feed.

Space-savers, the new kilns occupy but one-fourth the space taken by tubular units of the same capacity. Maintenance costs are far lower, too. In fact, the Herreshoffs haven't had to be shut down for repairs since they started up, one in December 1953 and the other in the fall of 1954.

Actually, Corn Products had been considering the Herreshoff kiln as an improved device for reactivating bone char, would eventually have gone over even if granular activated carbon hadn't come along. But the PCC advantages tied the economics neatly together and CP didn't have to justify kiln cost solely on the basis of the new carbon.

▶ **Clinton, Too**—Although Corn Products tried PCC carbon as early as 1951—at a pilot plant at Cardinal, Ont.—development of the present dextrose refining process involves improvements made by Clinton Foods. In October 1950 Clinton set up the first commercial installation of PCC carbon. Unable to reactivate the spent carbon in its vertical kilns, Clinton had to ship the stuff back to Pittsburgh for reactivation. Then, in 1952, Clinton put in a six-hearth Herreshoff.

Clinton's report on more than four years of operation with granular activated carbon is equally favorable. Clinton claims 100 lb. of granular activated carbon satisfactorily decolorizes 5,000 lb. of dextrose process liquor, whereas the same weight of bone char could handle only 290 lb. of liquor. Furthermore, kiln load with this new carbon is greatly reduced. On a volume basis it's necessary to regenerate only one-sixth as much decolorizer as before.

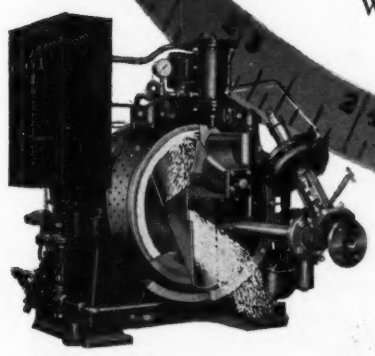
▶ **Debits**—PCC SG carbon has drawbacks to be reckoned with, however. The most serious: a high iron content which the liquors tend to leach out; also, the absence of bone char's significant and desirable ash adsorption capacity (Pittsburgh carbon actually tends to throw ash into liquors).

Pittsburgh Coke & Chemical claims its newest carbon, Type SGL, will ease most of these objections. SGL's iron content is half that of SG, has less than 8% total ash. A test batch of SGL has worked well for Corn Products without an acid washing to remove iron.

▶ **Worth a Look**—These Herreshoff kilns are by no means new equipment. Nevertheless, they bear examining by the chemical engineer using a decolorizing carbon—be it bone char or activated granular—that needs reactivation.

* This figure includes extensive alterations to building structure and conveying equipment made at the time of Herreshoff installation. Nichols Engineering and Research Corp., designer and builder of these furnaces, estimates the cost to install a similar Herreshoff kiln with accessories at about $135,000. Pittsburgh Coke and Rust Eng. are working on a fluid bed kiln which they hope will increase kiln efficiencies and reduce capital cost.

The Measure of a Crystal Dehydrator



Lowest possible moisture content . . . high capacity . . . low maintenance costs . . . high purity . . . continuous automatic operation.

—these are acknowledged facts about the Sharples Super-D-Hydrator, available in two sizes of bowl: 20 inch and 27 inch.

Long experience with larger bowl centrifuges (Sharples once manufactured a 63 inch machine) proved however, that there is no substitute for high centrifugal force where crystal dryness is concerned. A larger bowl would only serve to reduce the speed, and the centrifugal force; therefore, drying efficiency would suffer greatly.

With its continuous cyclic operation, the 27 inch Super-D-Hydrator produces up to 8 tons of crystals an hour, day in and day out at low cost—with minimum moisture content. This kind of production is the best buy per dollar invested in crystal dehydration. We'd be glad to show you the detailed facts.

Write for Sharples Bulletin 1257

SHARPLES

THE SHARPLES CORPORATION
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Diamond Steps Up Chlorine Activity

Nearly a year ahead of original plans, Diamond Alkali has put into operation the second and last series of cells at its newly acquired Muscle Shoals, Ala., plant. The first series started running last March.

Reason for the speedup is the exceptionally strong market for chlorine in the Muscle Shoals area.

European Ammonia Process Available Here

With the tremendous upsurge planned for ammonia capacity, it's not surprising to see new and improved processes being offered. Latest to make its U. S. debut is the L'Azote process owned by SBA (Societe Belge de L'Azote et des Produits Chimiques du Marly) of Belgium. Koppers Co. of Pittsburgh, Pa., has the North American rights to design, construct and license plants.

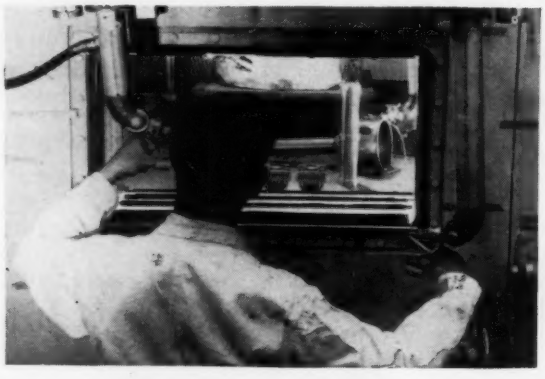
Though new to this country, the L'Azote process has been used for some time in Europe, particularly in conjunction with steel mills where hydrogen is obtained from coke-oven gas. Any source of hydrogen can be used, but Koppers, in discussing the process's potential, emphasizes the steel industry's special interest generated by dwindling revenue from sale of coke-oven gas.

Operating at moderate pressure—4,300 psig.—the L'Azote process is said to differ from other techniques mostly in reactor design. High efficiency and good utilization of waste heat are cited as the principal advantages. Excellent heat exchange (temperature difference between gas entrance and exit is 150 F). and good temperature control in the reactor help give these results: 25-30% ammonia formation per pass; 99% hydrogen conversion; catalyst consumption less than 0.116 lb./ton of ammonia produced; more than 50 lb./hr. of ammonia per cu. ft. of reactor capacity. In addition, byproduct steam is made that more than balances the steam needed to purify the coke-oven gas if that route is used.

Arizona Will Get New Fertilizer Facilities

Arrangements are nearly completed for a $13 million fertilizer plant near Kyrene, Ariz. Thunderbird Chemicals, Inc., will run the unit, which will make anhydrous ammonia, phosphates, sulfates and urea. Ebasco Services of New York is drawing up the plans.

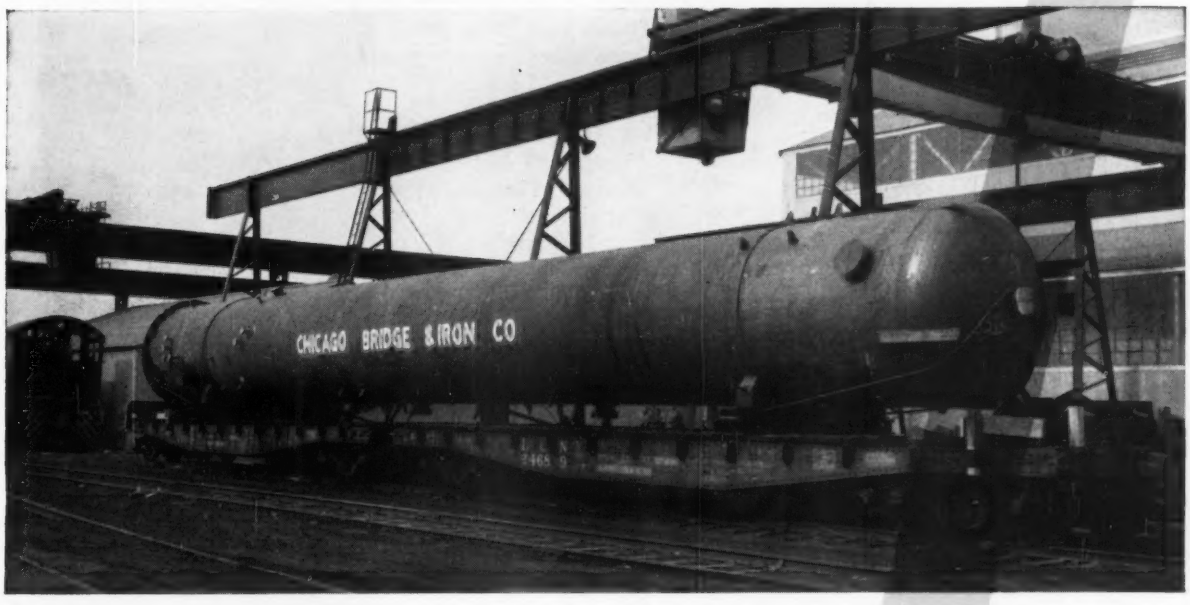
Also, near Phoenix, Ariz., Southwest Agrochemical Corp. is now planning a $2.5 million unit with an ultimate capacity of 100 tons a day of nitrogen products.



Atoms Start Working for Industry

Big-scale industrial gamma ray research is on as two chemical process firms receive big pieces of radioactive cobalt from Brookhaven National Laboratory. B. F. Goodrich's 1,500-curie package (shown leaving Brookhaven's water shield pit, right) is unique in that no concrete or lead "cave" is needed to protect researchers from radiation. Materials, mostly rubber and plastics, are inserted or removed from the five test chambers at Brecksville, Ohio, without intricate manipulators. Esso Research (above), however, houses its 3,500-curie piece in a concrete cave at Linden, N. J., uses remote control hands in its search to find new ways to modify and manufacture petroleum products.

the BIGGER they come



. . . the more exacting workmanship and knowledge required to build complicated welded steel plate structures. The 8-ft. diam. by 80-ft. CO_2 absorber tower shown above is an example. This structure was built by CB&I to exacting specifications under contract from Foster Wheeler Corporation for the Grace Chemical Company at Woodstock, Tennessee.

CB&I is a specialist. Their experience, ability and facilities will provide you with the best when your requirements are the greatest. Write our nearest office for further information.

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WHAT'S HAPPENING . . .

This Acid Plant Is Different

Novel stack design, huge converter, other process and equipment improvements feature Consolidated Chemical's newest sludge-acid regeneration plant.

No, that's not an optical illusion in the picture at the right, nor is it trick photography. The stack actually goes right through the middle of the water tower.

Engineers of Chemical Construction Corp. and Consolidated Chemical Industries hit upon this novel idea when designing the new 400-ton-per-day sulfuric acid regeneration plant at Baytown, Tex., in operation since the first week in May.

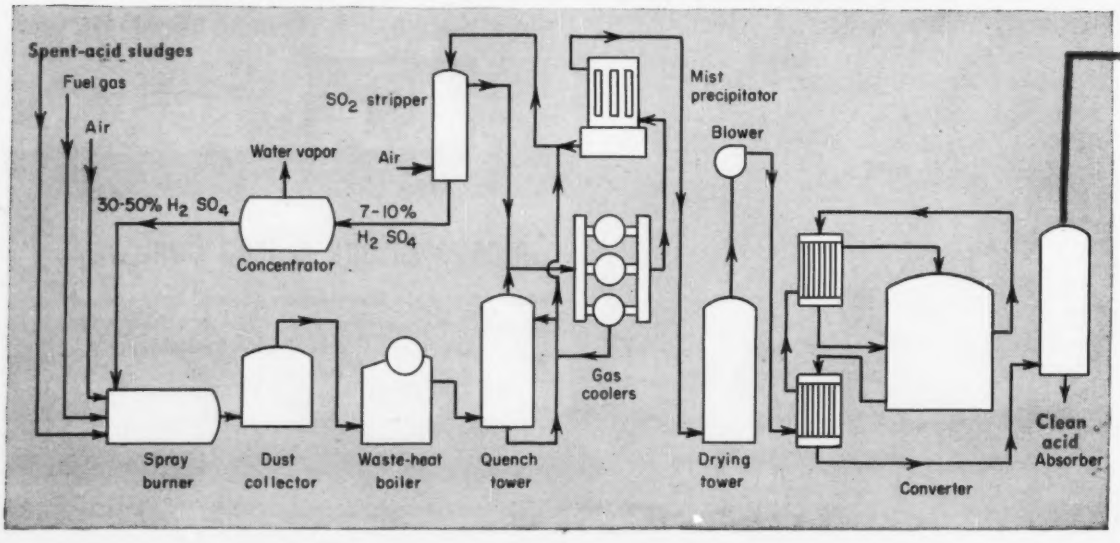
▶ **Three in One**–The combination stack-tower structure serves three purposes. In addition to the more obvious functions of the 200-ft. stack and the 125,000-gal. water tank, the lower 50 ft. of the stack–below the breeching–serves for storage of treated boiler feedwater.

This arrangement saves in ground space and money, both of which are becoming almost as important in some parts of Texas as they are elsewhere in the country. The water tank provides lateral support for the stack, eliminating the need for "dead men" and guy wires. The stack is insulated from the water in the tank by an annular dead-air space; expansion joints allow for expansion and contraction of the stack itself.

Purpose of the new plant is to regenerate clean, white acid from spent-acid sludges. The sludges come from nearby petroleum refinery and chemical manufacturing operations, such as lube oil refinery and alkylation reactions. They formerly were sent to the atmosphere.

▶ **Process Improvements**–Basic operations of the new plant–sludge burning, cooling and cleaning of combustion gases, and conversion to acid in a contact unit–resemble those of Consolidated's acid regeneration plant built two years ago at Baton Rouge, La. (see *Chem. Eng.*, Jan. 1954, pp. 114-6). However, there are some important differences and improvements.

In the first place, the Baytown plant makes 400 tons per day of acid in a single line. Consolidated officials say that it is the largest single sludge-acid regenerator unit



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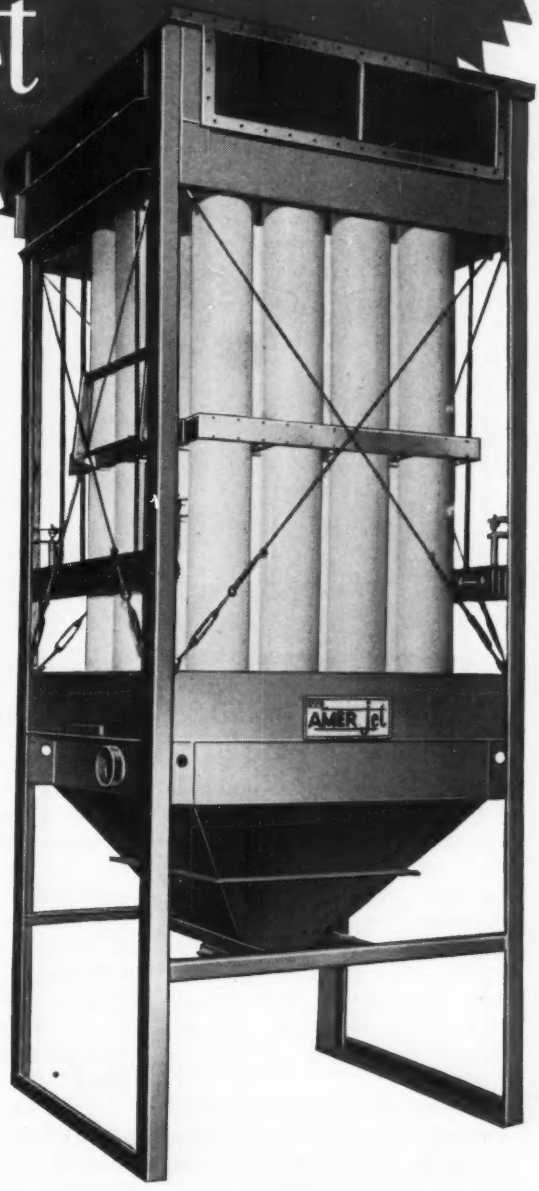
Dust That Must Be Reclaimed Dry

Add Up The Advantages of AMER Jet



OUTSTANDING PERFORMANCE. Constant air volume is assured by the automatic and continuous re-conditioning of the cleaning tubes by jets of high pressure air. This reverse jet principle permits velocities through the cleaning media up to *five times greater* than ordinary fabric collectors. With no fluctuation of pressure drop, loss of control at dust source and collection of excessive material are prevented. Collected material is a uniform product. Requires no re-mixing to eliminate layers of fine and coarse particles.

LOWER SERVICE COST. Five times greater capacity means 1/5 less inspection and replacement costs compared to ordinary fabric collectors. There are no bulky drape hose connections for high pressure air. AMERjet's moving shoe takeoff eliminates wear on hose and fabric. Unique automatic disconnecting clutch stops drive under abnormal load, prevents jamming or breaking of drive parts.

SMALLER SPACE REQUIREMENTS. AMERjet is manufactured in the space-saving tradition of all AAF Dust Control Equipment. Because of compact design and factory assembly, AMERjet is easily erected on the job at minimum cost. Unit can be located close to dust source, eliminating long duct runs.

AMERjet Fabric Dust Arresters are available for handling any exhaust volume. For complete information, call your local AAF representative or write direct for Bulletin 279.

AAF herman nelson

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COMPANY, INC.

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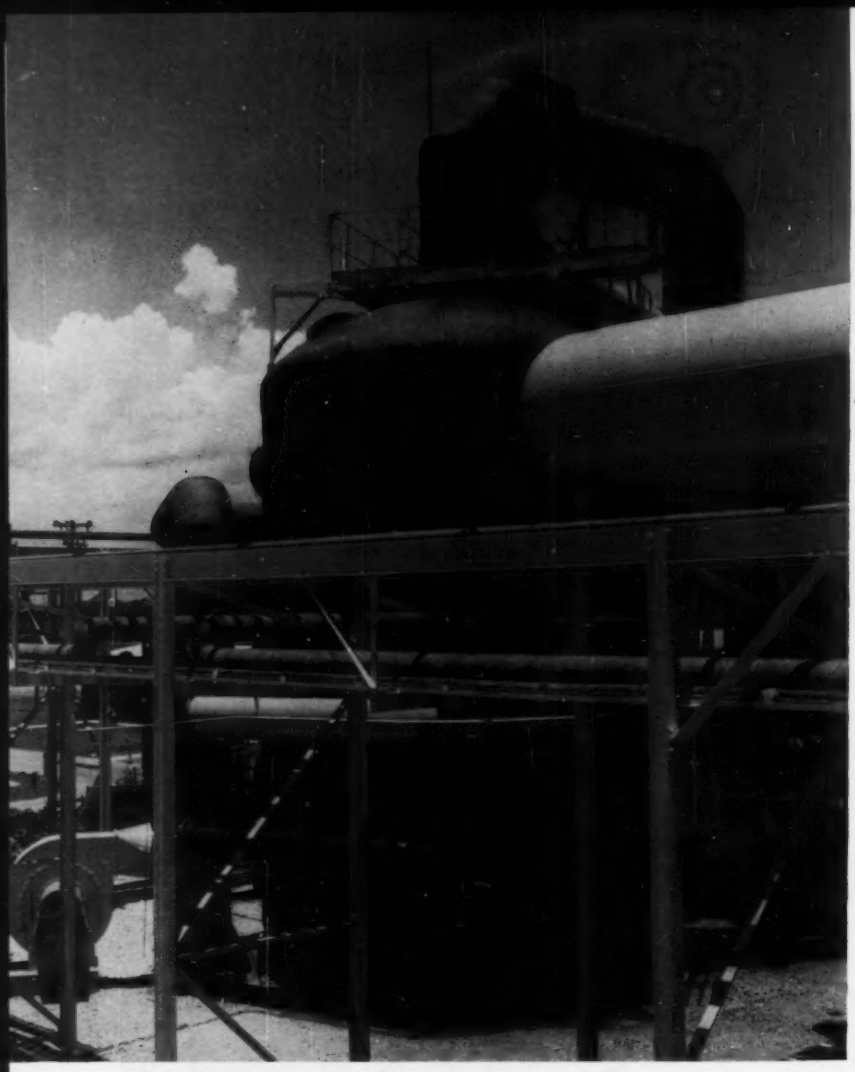

CONVERTER turns out 400 tons per day of sulfuric acid in single unit.

ever built. (Baton Rouge's 400-ton capacity is divided between two parallel lines.)

All the condensate or weak-acid drip from the gas coolers and precipitators is put through an auxiliary acid concentration unit (*see flowsheet*). Purpose is to maintain the water balance for the entire plant by expelling water from the system. Since the weak acid contains dissolved SO_3 it is stripped prior to concentration, with recovered SO_3 returned to the system.

Added advantage of drip-acid concentration is that it eliminates any acidic effluent from the process. In order to dispose of any other acid which might find its way into the plant wastes, all effluents go through a sewer sump pit. The pH of the combined effluent is controlled by an automatic lime feeder.

Inasmuch as the plant will handle acid sludges containing higher concentrations of hydrocarbons than previous plants, Consolidated had to provide some means to prevent excessive temperatures in the combustion chamber. This is done by recycling a controlled volume of weak acid from the scrubbing cycle through the furnace.*

▶ **Engineering Improvements**—In addition to the combination stack-tower, Consolidated's engineers came up with some other improvements:

• A waste-heat boiler generates steam for running the 1,050-hp. turbine-driven main gas blower. Although waste-heat boilers are common in conventional contact acid plants, use in a sludge-acid regeneration plant is claimed to be novel. This one cools the gas from the combustion chamber so that less cooling is required in the quench tower, thus decreasing the amount of water vapor which must subsequently be taken out of the SO_2 gas before it can be sent to the drying tower and converter.

• Final gas cooling is done in five impervious-graphite coolers, so arranged that any one of the units can be isolated for repairs. Consolidated officials decline to release any details about construction of these coolers.

• The dust collector is so designed that it may be blanked off from the combustion furnace and used as a small furnace itself if the main furnace is down for repairs.

• Steam balance in the plant is maintained by an automatic, natural-gas-fired, stand-by boiler.

• All sludge storage tanks are vented through saran-lined steel pipe and a stainless steel flare arrestor back into the process. This avoids corrosion and pollution.

And it makes sense that a plant designed to eliminate a major pollution problem should take adequate precautions itself to avoid all appearance of pollution evil.

*Heat balance in the furnace depends on the relative proportions of heavy sludges and spent alkylation acids. When the plant is operating predominantly on alkylation acids, with their lower hydrocarbon content, auxiliary fuel in the form of natural gas is needed in the furnace. Where possible, however, the various types of sludges are blended to provide more uniform operating conditions.

Los Angeles Mobilizes Against Smog Attacks

Following a pattern that looks much like air raid precautions, Los Angeles County has set up a system of smog alerts to warn residents when air contaminants reach danger levels.

The first alert, to be relayed through all forms of public communication when danger is near, would ban all unauthorized rubbish burning. Voluntary limitation of nonessential vehicle use would also be requested and plants would be warned to prepare to shut down.

When a preliminary stage of danger is reached, a second alert would call the Air Pollution Control Board into session. The Board could mandatorially limit vehicu-

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all-welded heavy gauge insulation jacket

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lar traffic and shut down commercial firms contributing to the condition.

The third alert allows the governor to declare martial law in the affected area. It's considered very unlikely that this step will ever be needed.

Conditions calling for the alerts are: first, 100 parts of carbon monoxide, 3 parts of nitrogen or sulfur oxides or 0.5 parts of ozone per million parts of atmosphere; second, 200 parts of CO, 5 parts of nitrogen or sulfur oxides or 1 of ozone; third, 300 of hydrocarbons, 10 of nitrogen or sulfur oxides or 1.5 of ozone.

Hydrocarbons Rescued From Natural Gas

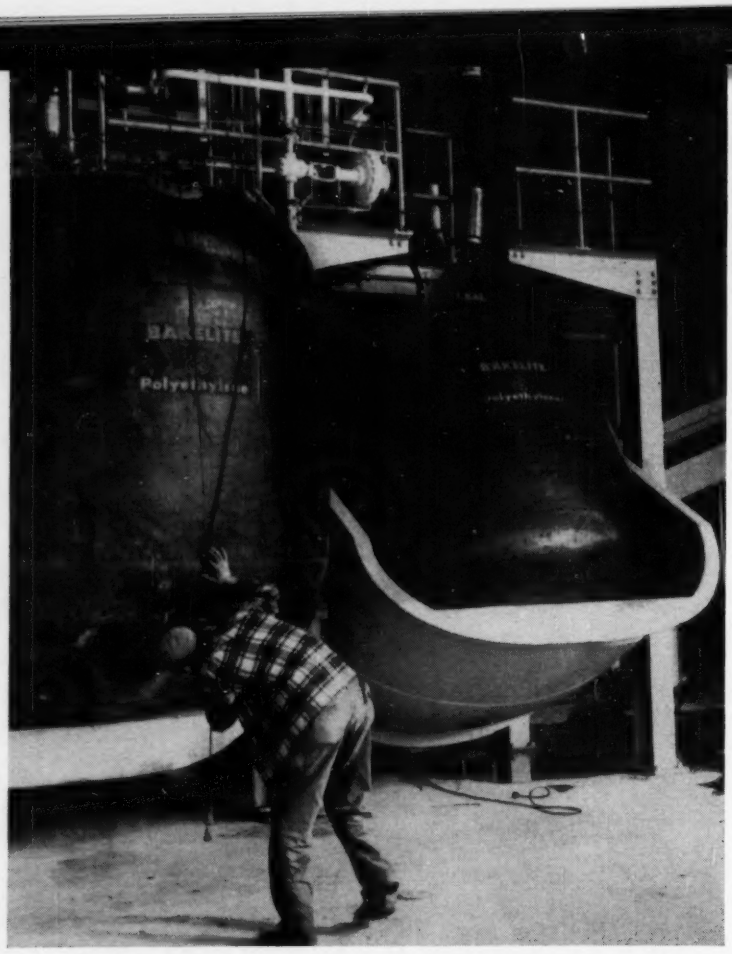
With the installation of a new Rotasorber process, natural gasoline and other liquid hydrocarbons now going to waste in natural gas pipelines will be recovered at Atlantic Refining's Bayou Sale oil and gas field in St. Mary Parish, La. In the process, gas is dehydrated and liquids selectively removed simultaneously with a dry absorbent.

Jefferson Lake Sulphur Co., process developer, will build and operate the plant which will be completed by year's end. It's designed to handle about 40 million cu. ft. of gas a day.

New Sulfuric Plant Will Supply South

A modern $2 million contact sulfuric acid plant will be completed by mid-1956 in Le Moyne, Ala., by Consolidated Chemical Industries Inc. Adjacent to the Courtaulds (Ala.) Ltd. viscose rayon works, the Le Moyne plant site will make the fifth from which Consolidated supplies sulfuric acid to southern and southwestern markets.

In the same field, Consolidated has just installed new twin units for spent sulfuric acid regeneration at its Houston and Baytown, Tex., works. They are the largest ever built. (See p. 128.)



1 CRADLE tilts inflated synthetic rubber containers to a 45-deg. angle preparatory to filling with 9,400 lb. of polyethylene resin.

Bulk Shipment Pays Off

Collapsible containers for moving polyethylene resins from producer to fabricators reduce labor costs, eliminate contamination, save warehouse space.

Savings of as much as one-third of a cent per lb. are estimated by Bakelite Co. for its new system of shipping polyethylene resins in bulk using collapsible neoprene containers.

Each container, holding 9,400 lb. of resin, replaces about 190 paper bags. Adapted to mechanized handling methods, the containers reduce the customer's manpower for receiving bulk shipments to a maximum of one operator.

Although Bakelite assumes the major investment cost in the new system, the customer's initial investment in equipment may range from about $15,000, to handle 250,000 lb. per month, up to $40,000 for higher consumption rates. To justify the investment, in addition to labor savings, are these other advantages:

- Completely enclosed filling and unloading operations eliminate product contamination by flyash, dirt, cut bag fibers and other materials.
- Outdoor storage of the weatherproof containers saves in valuable warehouse space.
- Containers fit comfortably into railroad gondola cars and open-top truck trailers.

Made by United States Rubber Co., the containers are being tested for shipment of other materials, such as carbon black and calcium carbide.

Picture story continues on page 134 ➡

You get more
than a mixer at
SPROUT-WALDRON

You also get reliable guidance on installations and applications from our engineering representatives. They are in a position to recommend, without bias, the exact mixer to do your job best. That's because Sprout-Waldron offers complete lines of all types of mixers—verticals, horizontals, continuous, and blenders.

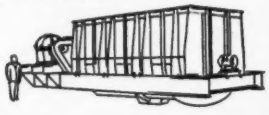
BRUCE BROWN

Sprout-Waldron representatives are thoroughly experienced in solving mixing problems for the processing industries.

A typical sales engineer is *Bruce Brown*, pictured here, who came with Sprout-Waldron directly from Stevens Institute. After 2 years at the home office in the engineering, experimental and cost departments, Bruce became a Sprout-Waldron representative. His ability to analyze difficult processing problems and suggest solutions has made him valuable to the customers he serves.

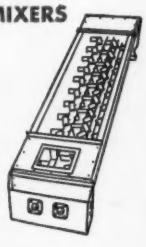
With such men to help you, you are assured of economical, efficient equipment and service from Sprout-Waldron.

SPROUT-WALDRON
BATCH MIXERS



For the rapid, intimate mixing of small percentages of a number of critical ingredients with large percentages of basic material, a Sprout-Waldron Style "B" Horizontal Batch Mixer can cut costs and improve quality of end products.

SPROUT-WALDRON
CONTINUOUS MIXERS



These large, double-agitator mixers are ideal for adding hot or cold liquids, viscous or otherwise, to dry materials on a continuous basis.

SPROUT-WALDRON
MATERIALS HANDLING
EQUIPMENT

To get materials to and from mixers, Sprout-Waldron offers complete lines of screw and belt conveyors, bucket elevators, feeders, and the revolutionary Pneu-Vac air handling system.

SW

any MIXER YOU NEED

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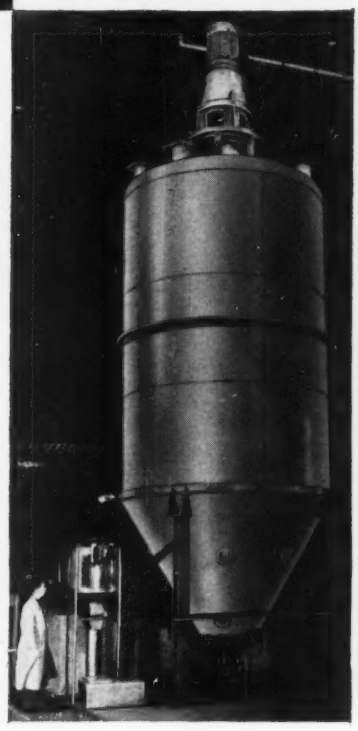

in size and quality...

Here are, we believe, the world's largest and the world's smallest vertical mixers—both Sprout-Waldrons. The giant at the right has a capacity of 1500 cu. ft. The capacity of the pygmy on the left is 10 cu. ft.

SPROUT-WALDRON
VERTICAL MIXERS

You'll find at Sprout-Waldron the greatest variety of vertical mixers—ranging from the world's largest to the world's smallest—with the most advanced features. They're money-saving answers to the problems of mixing dry, free-flowing materials of a uniform particle size because...

> Sprout-Waldron verticals permit the mixing of a limited amount of liquids with dry ingredients. They occupy little floor space and have low horsepower requirements. One with a capacity of 1500 cu. ft. takes up only 80 sq. ft. of floor space and operates on as little as 30 h.p. These mixers are completely self-cleaning and can be made dust-tight and pressure-tight. Loading or charging is fast from either the top or from the operating floor level. Available in wood, stainless steel, carbon steel, and non-ferrous or commercial alloys. Large models are ideal as mixing reservoirs or holding bins to maintain absolute uniformity of mixes that are produced from several production lines.

All equipment can be adapted to meet your special needs through Sprout-Waldron's unique "adaptioneering" methods. Let us advise you on your next mixer installation. Write for details.

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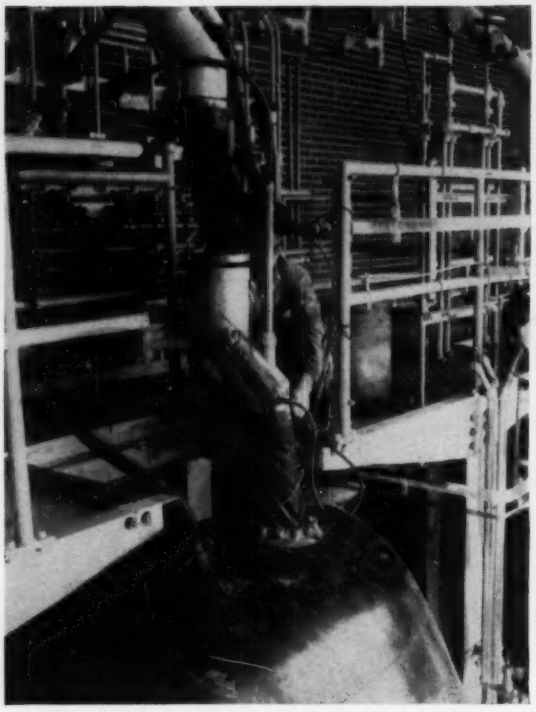
Facilities for fabricating, machining, custom founding, woodworking, laboratory testing

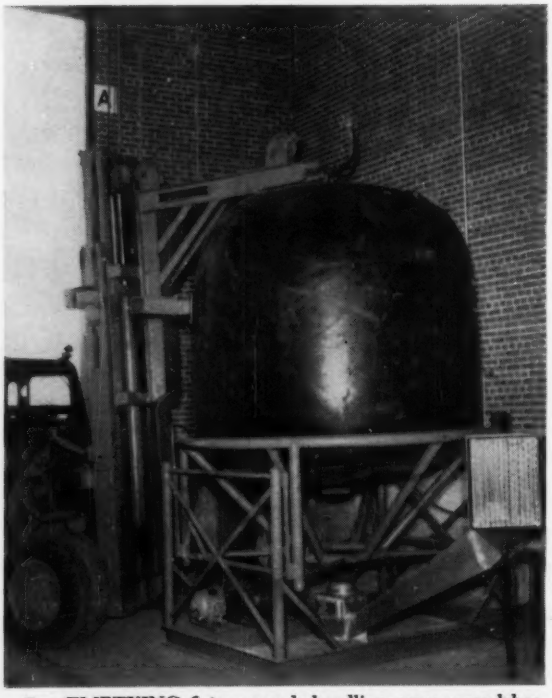
PR/40C

From Polyethylene Producer to Consumer, New Handling System Saves All the Way



2 FILLING under pressure keeps out dirt. Closure connects while under pressure with a filling spout through a special sleeve valve.

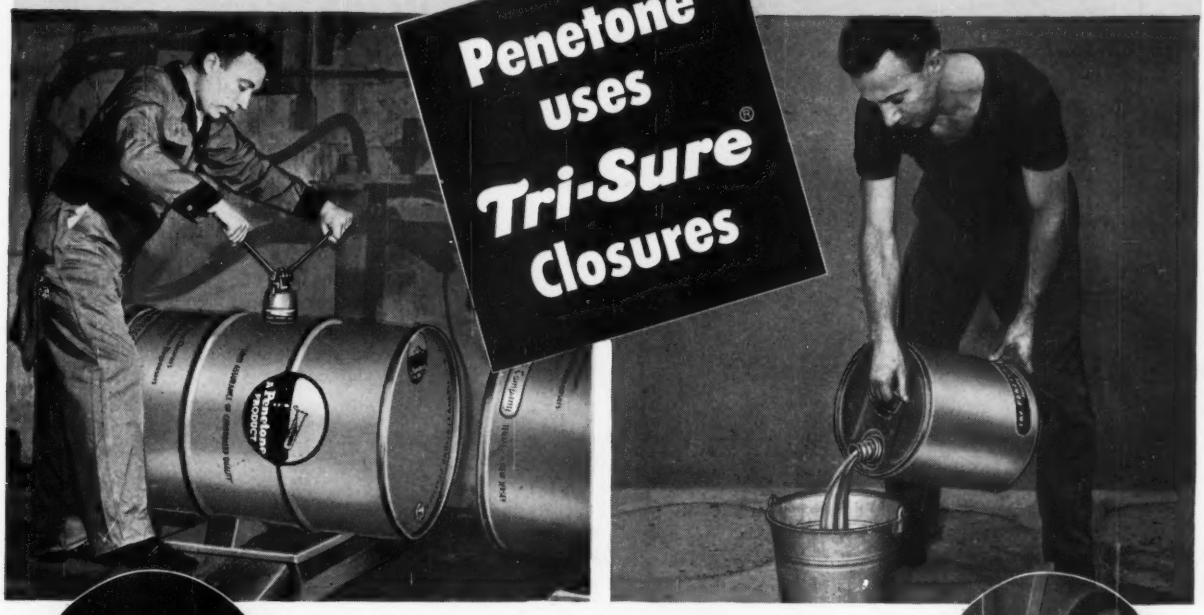
3 FREIGHT car can be unloaded of its seven containers in one-half hour, compared with 16 man-hours for unloading shipment in paper bags.



4 EMPTYING fixture speeds handling, saves more labor. Sleeve valve, like that used for filling, maintains product cleanliness, thus reducing rejects.

5 COLLAPSED container can be outdoors while awaiting return and refilling, saving warehouse space valued at 60-80¢ per sq. ft. per year.

Penetone makes dependable shipments in drums..... ....in pails



Tri-Sure Closures On Penetone Drums

Penetone Drums can be shipped any distance with perfect security from leakage, contamination or substitution because they are equipped with Tri-Sure Closures—with a flange that is integrally joined to the drumstock, a plug that is screwed securely into the flange, and a leakproof seal.

Specify Tri-Sure Closures. Your drum manufacturer will supply drums equipped with Tri-Sure Flanges and Plugs; you apply the Seals.

More than 150 chemical cleaners, degreasers, waxes and protective coatings are manufactured by the Penetone Company of Tenafly, N. J., which also makes and fills private label chemicals on contract.

This big Penetone Line is known throughout the country for the dependable *quality* that is put into every product—and protected from impurities by *Tri-Sure Closures**.

Penetone Products—in drums guarded by the Tri-Sure *Flange*, *Plug* and *Seal* and in pails equipped with the *Tri-Sure Tru-Pour Assembly*—create goodwill wherever they go, because these Tri-Sure equipped containers give better protection and easier handling.

Sound protection is sound business—which is why more and more shippers are using Tri-Sure Closures on *all* their containers.

When you order drums, pails or cans, always specify "Tri-Sure Closures".

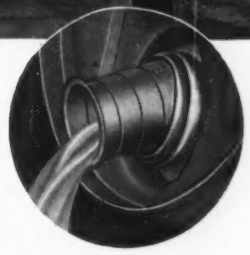
**The "Tri-Sure" Trademark is a mark of reliability backed by over 30 years serving industry.*

Always specify

Tri-Sure

Reg. U. S. Pat. Off.

CLOSURES



Tri-Sure Tru-Pour Spouts On Penetone Pails

Penetone uses this closure because it has a collapsible spout which makes pails easy to stack.

The spout can be quickly extended to direct the flow into an opening, and easily collapsed for re-sealing.

The Tru-Pour is one of several unique Tri-Sure assemblies for pails and cans. Specify Tri-Sure Closures to your pail manufacturer. You will get pails equipped with Tri-Sure Assemblies—Nozzles, Spouts, Seals.

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Tri-Sure Products Limited, St. Catharines, Ontario, Canada
Tri-Sure S/A Indústria e Comércio, Sao Paulo, Brazil

Dow's Glycerine Team Christens First Tankcar

These 22 men, who spearheaded Dow Chemical Co.'s research, development, design, construction and plant startup on synthetic glycerine, observed the loading of the first tankcar of product from the new plant at Freeport, Tex., on June 23.

Through their efforts Dow compressed into a little more than three years its complete synthetic glycerine development program. Laboratory work began in March 1952.

As Vice President A. P. Beutel commented, "Three years is an unusually short time for covering so much ground, and the people who made it possible certainly deserve great credit. I'm sure that their accomplishment will cause quite a stir in the entire industry—which regards five to seven years as a good time span between laboratory and plant."

New Galvanic Cell Uses Oxygen, Hydrogen

Without intermediate boilers, turbines or generators, a 2-3 kw. prototype cell is planned in England to supply electricity directly by the reverse of water dissociation —oxygen and hydrogen combining to form water. Developed by F. T. Bacon of Cambridge University, a 5-in. diameter lab unit has run over 1,000 hours at 65% efficiency.

Two big advantages are claimed: The electrodes do not deteriorate; previous cells with reasonable efficiency deteriorated rapidly. Secondly, it's relatively light. A lead storage battery for traction uses (like trucks or electric railways) has a weight-to-power ratio of about 85 lb./kwh. of power stored and its capacity is limited. In a railroad engine, for instance, this cell would have a ratio of about 50. And capacity is limited only by the amount of high-pressure gas available—stored in cylinders if a portable installation. However, Bacon figures his cell in a typical traction unit would be only 40% efficient, compared with 75% for a lead cell.

In a stationary electric plant, these cells could be a big help in smoothing out peak load problems. During low loads hydrogen and oxygen could be stored for peak times. Theoretically, at least the same cell could be run backwards to generate hydrogen and oxygen, though in the lab a separate electrolyzer was used.

The cell works like this: Centered between halves of a nickel-plated cylinder are porous nickel electrodes ⅛-in. apart, with a 27% potassium hydroxide solution between the electrodes. Between the electrodes and the walls are oxygen on the positive side and hydrogen on the negative.

A thin layer of nickel oxide on the positive electrode absorbs and activates the oxygen which reacts with water in the electrolyte to form hydroxyl ions. These move to the negative electrode through the electrolyte, combine with hydrogen to form water and release their electrons. This gives a potential difference and current flows from the negative to the positive electrode. To use this current you simply hook your circuit between the electrodes.

Best lab conditions were 392 F., 600 psi., giving 25 amp. at 0.8v. To boost amperage, Bacon plans a 10-in. diameter prototype cell. Voltage increases with the number of cells in series and Bacon sees no reason why you couldn't have 100 or more cells.

News Briefs

Ammonium bicarbonate: Allied Chemical's Solvay Process Div. is increasing capacity of its Syracuse, N. Y., ammonium bicarbonate plant by 25%. Expansion should be completed this year.

Solvent, plasticizer: Celanese Corp. of America has a new process for ethylene glycol diacetate, useful as both a solvent and a plasticizer. Volume production has begun at Bishop, Tex.

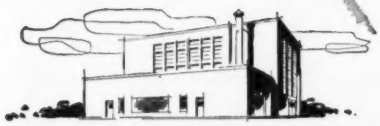
Tall oil: Arizona Chemical Co. has boosted its capacity for fractionated tall oil products at Panama City, Fla., by 2½ times.

Sufite pulp: Weyerhaeuser Timber Co. late this year will start building a $20 million bleached-sulfite-pulp mill at Cosmopolis, Wash. Completion of the 400-ton-per-day unit is set for 1957. A magnesia process will be used.

Chromic acid: Diamond Alkali Co., at Painesville, Ohio, has started up a completely integrated chromic acid plant.

Kraft pulp: Brown Co. has broken ground at Berlin, N. H., for a $3.5 million kraft pulp bleachery. Operations will begin next summer.

Want to know if it can be spray dryed?



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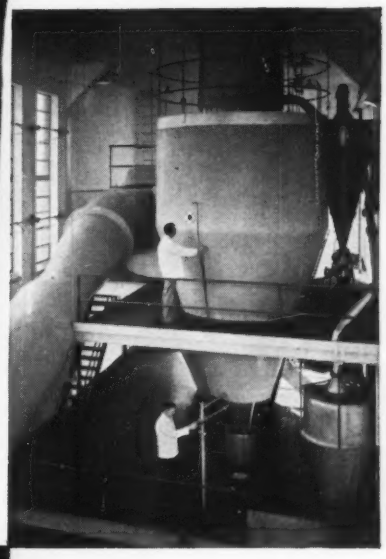

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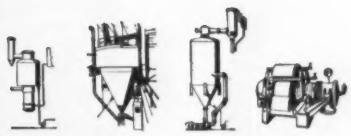

Evaporators • Spray Dryers • Crystallizers • Filters

Tubing Selection for

Oxidation Resistance

The loss of metal through scaling at high temperatures is a phenomenon that causes the loss of money, time and labor in replacement cost, downtime and maintenance. As technological advances are made in the various process industries and operating temperatures increase, greater attention must be paid to this problem. As these new process methods are developed, the means by which they can be economically implemented becomes more and more complex. This is particularly so in the selection of tubing and piping as the choice of grade is usually complicated by other necessary considerations, such as—operating pressures, corrosive environments and fabricating problems.

For instance—if the operating temperature in a given installation in which oxidation resistance at 1500 F. is of prime importance, the accompanying table indicates that satisfactory results could possibly be obtained with any of eight grades. These eight grades, however, have differences in corrosion resistance, high temperature strength, cost and fabricating properties. This makes the choice of the optimum grade a rather complex problem.

The first step in choosing the optimum tubing material for any particular high temperature installation is the choice of a manufacturer whose experience and knowledge can be applied to a given problem. It takes an expert to specify the right tube for any particular application, and there is no substitute for the kind of expert attention to these problems you'll find at B&W.

To get the most benefit from B&W's long experience in matching tubes to jobs, call on Mr. Tubes, your nearby B&W Tube Representative. He can help you, as he has helped hundreds of others, make tubing selection surer.

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TUBULAR PRODUCTS DIVISION
General Offices: Beaver Falls, Pennsylvania
Plants and Products
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Alliance, Ohio—Welded Carbon Steel Tubing
Milwaukee, Wis.—Seamless Tubing; Welded Stainless Steel Tubing; Seamless Welding Fittings

Recommended maximum temperature limits for satisfactory operation under oxidizing conditions without excessive scaling.

B&W CROLOY	ASTM-ASME GRADE	TEMPERATURE (F)
1¼	T11, P11	1100
2¼	T22, P22	1175
5	T5, P5	1200
9M	T9, P9	1300
12 A L	TP405	1400
12	TP410	1400
18	TP430	1600
18-85	TP304	1600
16-13-3	TP316	1600
18-8 Ti	TP321	1600
18-8 Cb	TP347	1600
22	TP443	1800
25-20	TP310	2100
27	TP446	2100

TA-5047-P

NOTE: The temperature limits shown may have to be revised downward in the presence of combustion products or gases high in sulphur compounds and if vanadium-containing ash is present.

Aluminas . . .

Few formulas

$Al_2O_3 \cdot 3\ H_2O$
$Al_2O_3 \cdot H_2O$
Al_2O_3 · calcined
Al_2O_3 · tabular

Many uses

Refractories
Ceramics
Abrasives
Pigments
Fillers
Desiccants
Catalysts
Insulators

A Market on the Upgrade

Industry used 250,000 tons of these aluminas last year as processing materials. You may find among their properties and uses a key to some of your problems.

As the source of the nation's second ranking volume metal, alumina needs no introduction. It's many-faceted usefulness as a processing material may surprise many, though.

Of course considerable alumina does go into aluminum salts such as the chloride and sulfate. But what this story is primarily about is the growing market for aluminas—the several physical and hydrated forms of the basic chemical, Al_2O_3, that are pushing their way into multiple volume outlets ranging from refractories to paper.

You need little more than a quick glance at the properties possessed by one or more members of this family of aluminas to understand their versatility. From a list as long as your arm we might mention: high strength, resistance to mechanical shock, extreme hardness, high purity, stability to heat and thermal shock, chemical inertness, high or low density, dielectric strength, an avid affinity for water.

▶ **How Much and Where**—Of three million tons of alumina produced last year, 500,000 tons went to uses other than the production of aluminum metal. Reducing this portion further, we find that more than 250,000 tons of alumina remained essentially as Al_2O_3—was not converted to aluminum salts—to meet the demand for aluminas in industrial processing.

Accurate breakdown figures aren't available for volumes of alumina going to specific non-metal applications. You can get a good feel for the accelerated usage, though, by checking the surge in total alumina production—nearly 70% over 1951—with the increasing share of this alumina that's going to non-metal end uses—from 7% in 1951 to about 16% last year. It's a case of a bigger piece of a bigger pie.

And since consumption of alumina for aluminum salts is not much above the level of 1951 (in pounds), it's reasonable to conclude that non-metal, non-chemical salt use—use of aluminas as processing materials—is on the upgrade.

▶ **In the Lead**—Biggest booster and supplier of processing aluminas is, as you might expect, the No. 1 aluminum producer, Aluminum Co. of America. The last of four units at Alcoa's new "alumina chemicals" plant at Bauxite, Ark., went on stream recently.

The Arkansas plant's production will augment and diversify output from other units at East St. Louis, Ill., and Mobile, Ala. A complete range of hydrated, calcined and tabular aluminas—many of them of a higher purity and more uniform quality than was previously available—will be turned out at Bauxite.

Latest word from Alcoa is that production of hydrated aluminas for filler and pigment usage in the manufacture of plastics, rubber and paper is going up 40%. And full production of porous tabular alumina—a carrier in catalytic applications—is now under way.

▶ **Mechanical Ceramics** – Perhaps the most intriguing field in which aluminas are just catching on is what Alcoa calls "mechanical ceramics." These applications employ very hard, very pure grades of alumina fabricated to replace metal parts. Parts like pump and valve members, thread guides, insulators and sand-blasting nozzles—anything subjected to extreme wear and/or corrosion.

▶ **Other Ceramics**—Alcoa's most active outlets for aluminas at present are ceramics, refractories and catalysts, with the first two being best bets for the future.*

* One use for ceramics, sparkplug insulators, is said to take 10-20 million pounds of alumina all by itself. This is not too hard to believe if you think of the 6 million or so cars produced a year, more and more of which are powered by eight-cylinder engines.

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A Celite Filter Cake is hundreds of times finer than the finest wire mesh!
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Celite Filtration provides the critical purity required for antibiotics because it removes even the finest suspended solids. A Celite Filter Cake contains more than 2,500,000 filter channels per square inch of surface. The Celite method also provides high production volume because it permits fast flow rates.

Celite powders may be used with any type of conventional filter. The right balance between flow and capacity with degree of purity is easily achieved . . . first in building up a pre-coat of Celite on the filter medium, then by adding small amounts to the solution to form a continuously fresh filter surface. To meet different requirements, Celite comes in nine standard grades of microscopically controlled particle size. Utmost product uniformity is assured.

Because of its simplicity, flexibility and efficiency, Celite Filtration has become the standard for entire industries. For highest purity in antibiotics, for perfect clarity in food products, for removing impurities from chemicals, petroleum, and other products . . . Celite offers unequalled advantages.

Whatever filtration problem you face, it will pay you to investigate the Celite Filtration method now. A Johns-Manville Celite Filtration Engineer will gladly discuss your problem. For his services, without obligation, write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

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Newsworthy chemicals this month

Aluminas are versatile 140A
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Titanium powder 144A
Vinyls waterproof reservoir 144B
Mylar rope 146A
Emulsifiers 146B
Fire extinguisher 146C
Adhesive 148A
Chlorinated polymer 148B
Indirect insect control 148C
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Fluorochemicals reduce spray 148E
Dibutyl fumarate 148F

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Many properties of alumina that make it valuable in a host of jobs are pointed up in ceramic usage. In glass, for example, hydrated alumina reduces coefficient of expansion, thus increases resistance to shock; increases crushing and tensile strength; decreases devitrification, making glass more suitable for machine operations; provides brilliance and luster; and improves resistance to weathering and attack by liquids.

Calcined aluminas go into ceramics, too: to produce fused alumina abrasives; as a constituent of porcelain enamel, porcelain, and glass mixes; for electrical insulators and supports.

Low-soda calcined aluminas have high dielectric strength, resistance to mechanical and thermal shock, can withstand high voltages at high frequencies. Thus they are used for top grade electrical insulators and ceramic items like sparkplugs.

▶ **Refractories** – Calcined aluminas permit production of refractories which are stable under load at high temperatures, resist spalling and corrosive slags and gases, and have minimum porosity and shrinkage.

Refractory fabrication is right up the alley of tabular aluminas. In powder or granular form tabular alumina goes into high temperature brick, glass tank blocks, burner tips. Ball-form tabular grades are found in catalyst bed supports, refractory aggregate, stationary heating beds and heat exchange pebbles.

As for catalysts and catalyst carriers, hydrated aluminas get the call and the petroleum industry does most of the calling.

Abrasives–from emery wheels to polishing and buffing compounds–employ hydrated aluminas for soft, fine work and calcined aluminas for fused alumina abrasives.

▶ **Desiccants** – Possibly alumina's oldest non-metal-producing application is as the activated form to adsorb moisture. Activated alumina's tremendous surface area and affinity for water; its ability to be reactivated repeatedly without significant loss in adsorptive efficiency; inertness to most gases or vapors; ruggedness in the face of frequent saturations and reactivations have put it in the forefront of commercial desiccants.

It's employed to dry gases, liquids and vapors, for treatment of oils, for dehydrating cartridges in refrigerating systems and in process, and comfort air conditioning. Impregnated with cobaltous chloride, it's used as an indicator in breather equipment on tank cars, transformers and storage tanks, on pneumatic and electrical control equipment.

▶ **Fillers, Pigments**–The translucency (a refractive index close to that of vinyl resins) and high bulking value of alumina hydrates fit them for use as fillers for plastics, resins and varnishes. Brightness and fineness suit them for use as pigments in casein paints.

Pigments for the rubber industry, too, are hydrated aluminas. They impart high tear resistance, superior aging characteristics, abrasion resistance and good dielectric strength.

And in the making of high quality coated paper, hydrated aluminas produce, together with other pigments, high gloss and brightness, high ink receptivity and rapid drying. **140A**

Acrolein

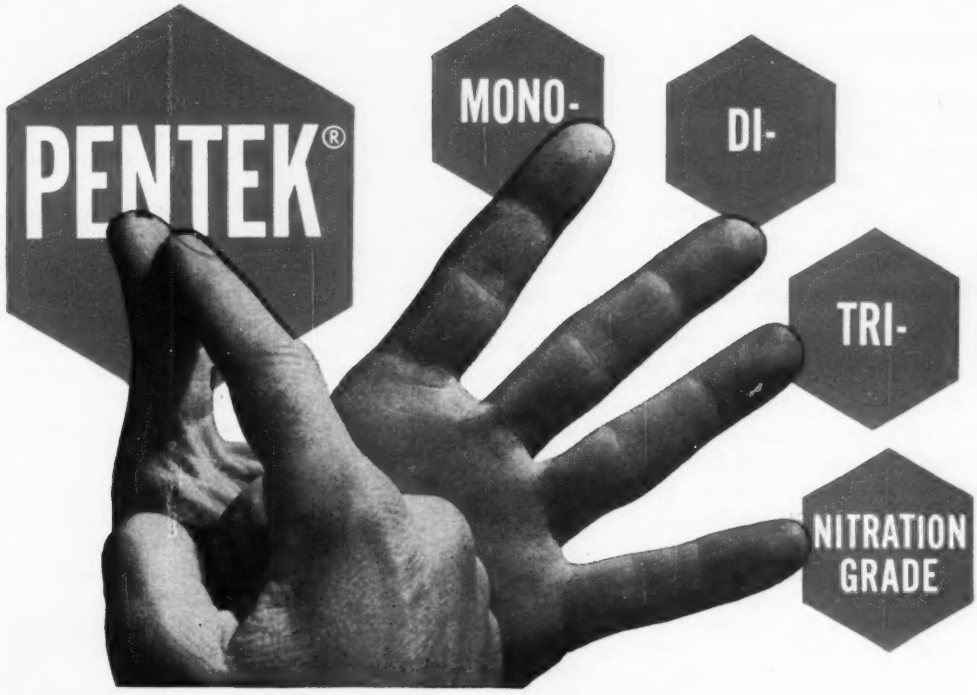
Increased supply assures brighter future for reactive chemical.

Chemical processors will want to reexamine acrolein in the light of recent developments. Achievement by Shell Chemical of a feasible, commercial synthesis of glycerin from hydrogen peroxide and acrolein means that the latter chemical will at last be available in commercial, low-cost quantities for wider use as a processing material.

Shell believes acrolein's versatility will place it alongside ethylene oxide, acetone and allyl chloride as a petrochemical serving nearly all branches of the chemical industry.

Here's how it might work for you: acrolein's carbon-to-carbon double bond can be reacted with halogens, halogen acids, alcohols, mercaptans, organic acids, water, bisulfites, compounds containing an active carbon to hydrogen bond, and molecular hydrogen. The carbonyl group reacts preferentially with acid anhydrides and hydrogen cyanide, less selectively with amines.

Acrolein enters into Diels-Alder reactions, serves as a diene or dienophile, or forms a dimer by



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combining both functions. Resultant products are in many cases as reactive as acrolein itself.–**Shell Chemical Corp., New York 20, N. Y.** **142A**

Titanium Powder

Chemical-electrolytic technique spawns a better product.

Titanium powder has not yet lived up to its exciting potential. United International Research believes it has lagged primarily because quality of grades on the market leaves something to be desired. Poor mechanical properties, pyrophoric tendencies, high impurities and non-uniformity are some of the objections raised.

UIR is accordingly advancing a titanium powder called Unifide which is produced by its own chemical-electrolytic process covered by patents pending. Unifide is available in a wide range of mesh sizes, is of consistent quality and non-pyrophoric under normal conditions of handling.

• Powder metallurgy: the big use for titanium powder. Titanium parts–bearings, filters, cutting tools –can be formed with controlled density (and porosity) and to close tolerances by subjecting the powder to 20-45 ton per sq. in. pressures and then sintering under vacuum or an inert gas. Adding small amounts of carbon and metal powders to titanium powder before pressing leads to harder and stronger finished members. Unifide titanium powder's spongy particle, which forms compacts with high green strength that sinter without tendency to deformation, should be of advantage here.

• Formation of titanium salts: Unifide, with its spongy nature and high surface area, reacts readily with certain chemicals–I_2, Fl_2, C. Since the powder is highly pure so can the chemicals be that result.

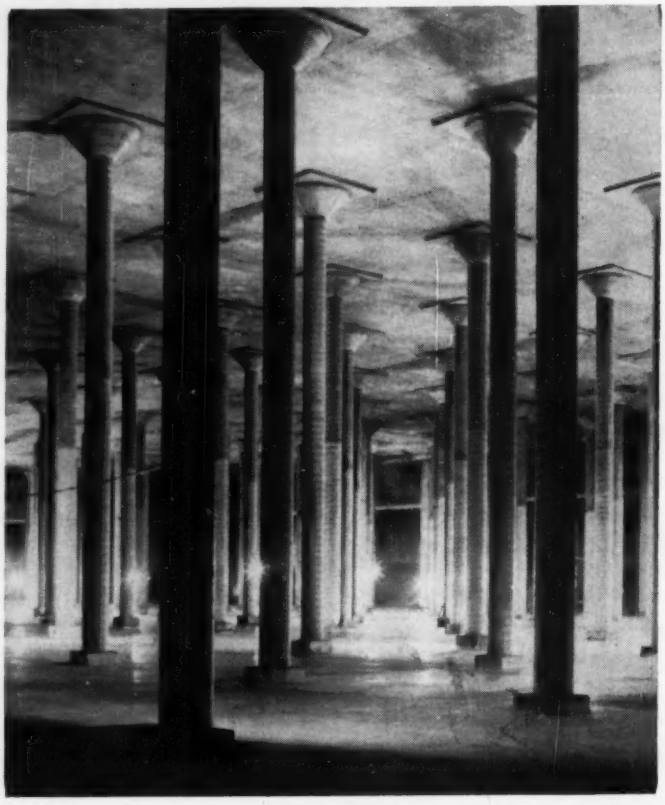
• Action as a reducing agent: Unifide's large surface area, together with reactivity of its salts of a lower valence, makes it a strong reducing agent in acid solution. In solid phase reductions at high temperature, titanium powder reduces many metallic compounds.

• Catalysis: Unifide titanium powder is readily compacted to form beads and pellets with high compressive strengths and controlled porosity for catalyst use. Large surface area and titanium's multivalent nature offer much in this area.

• Protective coatings: Putting titanium powder into selected vehicles containing small amounts of tough resin or plastic gives chemically resistant coatings. By increasing to putty consistency, these coatings may perform as corrosion-resistant filler for cracks and corroded spots.–**United International Research, Inc., New York, N. Y.** **144A**

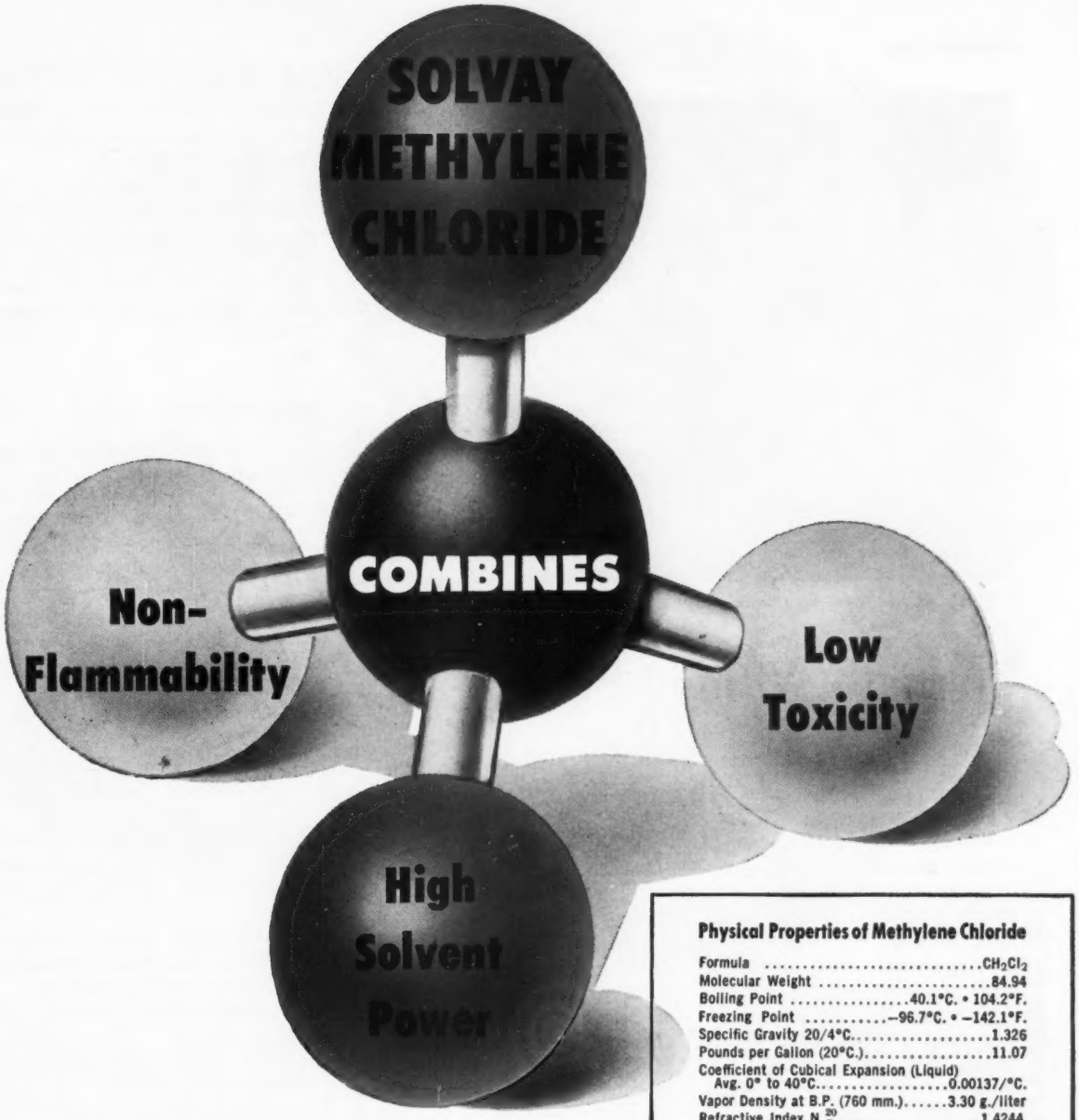
For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



Huge Job for Vinyls—Waterproofing a Reservoir

Although they may be look-alikes, no Grecian temple was ever as big as this underground reservoir of reinforced concrete. It holds 25 million gallons, is nearly two blocks long, one block wide and 35 ft. deep at the center. Spraying a vinyl based coating over miles of expansion joints inside the giant "tank" to stop excessive leakage from within was a big order. But the end justified the means. The flexible plastic skin moved with concrete contractions, squeezed seepage to a trickle–1½ to 2 gpm.–Bakelite Co., New York 16, N. Y. **144B**



Combining highly efficient solvent power with the safety of non-flammability and low toxicity, Solvay Methylene Chloride has found many diverse industrial uses such as: the active ingredient in paint remover formulas; an efficient extractant for heat sensitive compounds or organic compounds of a non-polar nature; a solvent and diluent in aerosol packaging; and as a solvent in the manufacture of photographic films and other forms of cellulose acetate.

The coupon will bring you further information or a sample—without cost or obligation.

Physical Properties of Methylene Chloride

Formula	CH_2Cl_2
Molecular Weight	84.94
Boiling Point	40.1°C. • 104.2°F.
Freezing Point	−96.7°C. • −142.1°F.
Specific Gravity 20/4°C.	1.326
Pounds per Gallon (20°C.)	11.07
Coefficient of Cubical Expansion (Liquid) Avg. 0° to 40°C.	0.00137/°C.
Vapor Density at B.P. (760 mm.)	3.30 g./liter
Refractive Index N_D^{20}	1.4244
Viscosity Liquid (20°C.)	0.430 centipoise
Surface Tension (in air) 20°C.	28.12 dynes/cm.
Specific Heat of Liquid (20°C.)	0.284 cal./gm./°C.
Latent Heat of Vaporization (at B. P.)	78.7 cal./gm.
Critical Temperature	245.0°C. • 473.0°F.
Critical Pressure	60.9 atm.
Flash Point	None

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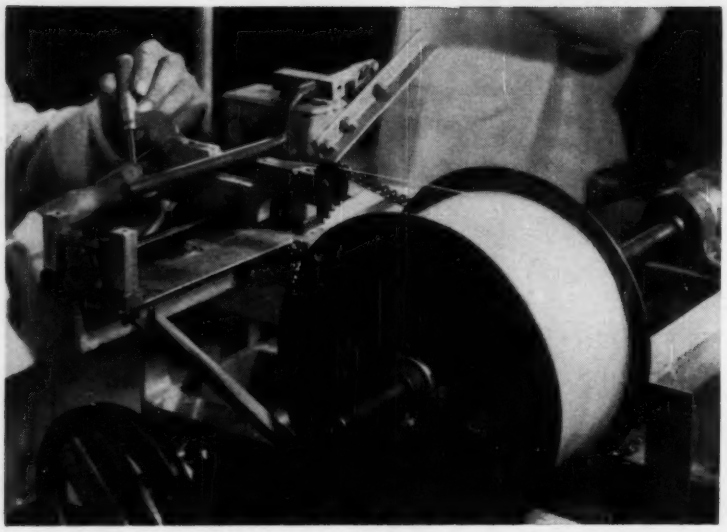
Methyl Chloride • Ortho-dichlorobenzene • Monochlorobenzene
Carbon Tetrachloride • Chloroform • Methylene Chloride



MYLAR ROPE: Spin, then twist, to get . . .

Strength Without Stretch

Toughness, dimensional stability. Mylar rope gives an extra measure of these properties—at a price.

Based on an exceptionally rugged material like Mylar polyester resin, a rope is bound to be pretty good—strong, dimensionally stable, chemically resistant. But because that basic resin costs about $3 per lb., Mylar rope isn't going to be cheap.

These are the factors any rope-user must consider when he appraises U.S. Plastic Rope's new rope—the first successfully fabricated from Mylar.

USPR (U.S. Plastic Rope) freely admits high cost—more than twice that of nylon—is a problem right now. But the company claims top properties for its rope, properties which, it feels, will carry the product, like nylon and Dacron ropes before it, into markets where application requirements, rather than cost, dictate usage* (Two of the biggest potential uses right now are water ski tow ropes and tether lines for blimps.)

Already dozens of industrial firms have Mylar rope under test in applications ranging from use around fissionable material to routine rope work where acids and fumes are encountered. Combination ropes—Mylar and polyethylene or copper wire—are a promising field, too.

Mylar rope has greater dimensional stability than either nylon or Dacron, can take more abuse, says USPR. And it has far less stretch than either of the other plastics—a decided advantage in uses where constant length must be maintained. Under tension a $\frac{7}{16}$-in. rope especially designed for Goodyear Aircraft blimp applications showed only 2.25% elongation at a 1,000 lb. working load.

As for tensile strength, $\frac{1}{4}$-in. Mylar line breaks at 1,400 lb., compared with filament nylon (the toughest rope before Mylar) at 1,200 lb., Dacron at 1,080 lb. and manila at 600 lb.

And abrasion resistance: Mylar rope holds up longer than nylon under abrasion. USPR expects equal advantages over Dacron in future tests. A $\frac{5}{8}$-in. manila line snapped at 13,445 cycles of a recent friction endurance test (load factor of 750 lb.) whereas Mylar rope of same diameter was still intact after 270,000 cycles.

You can buy Mylar rope in diameters of $\frac{1}{8}$ to 1 in., in standard three- and four-strand types, as well as cable laid. Cost: 25 per ft. for $\frac{1}{4}$-in. line, $1 a ft. for $\frac{1}{2}$-in. line—**U.S. Plastic Rope Co., Redwood City, Calif.** **146A**

* In cautioning against price over-emphasis, USPR says "cost comparisons of Mylar ropes with natural raw fiber are like comparing a Cadillac with a tricycle on the theory that each has wheels."

Emulsifiers

For paint, cosmetics, plastics, textile and paper industries.

Witco DGL, a diethylene glycol laurate blended with modifiers, is said to be self-emulsifying in water and a powerful emulsifying agent for other materials. It's moisture-free and doesn't evaporate at normal emulsifying temperatures or thicken on aging. In small amounts it's effective even as an antifoaming agent.

Here are some specific recommendations from the manufacturer for DGL usage.

- Paint industry: antifoam agent and emulsifying agent in rubber latex and resin emulsion systems.
- Textiles: control emulsion stability in lubricating compounds; emulsifier in finishing oils.
- Plasticizing: printing ink pastes, lacquers.

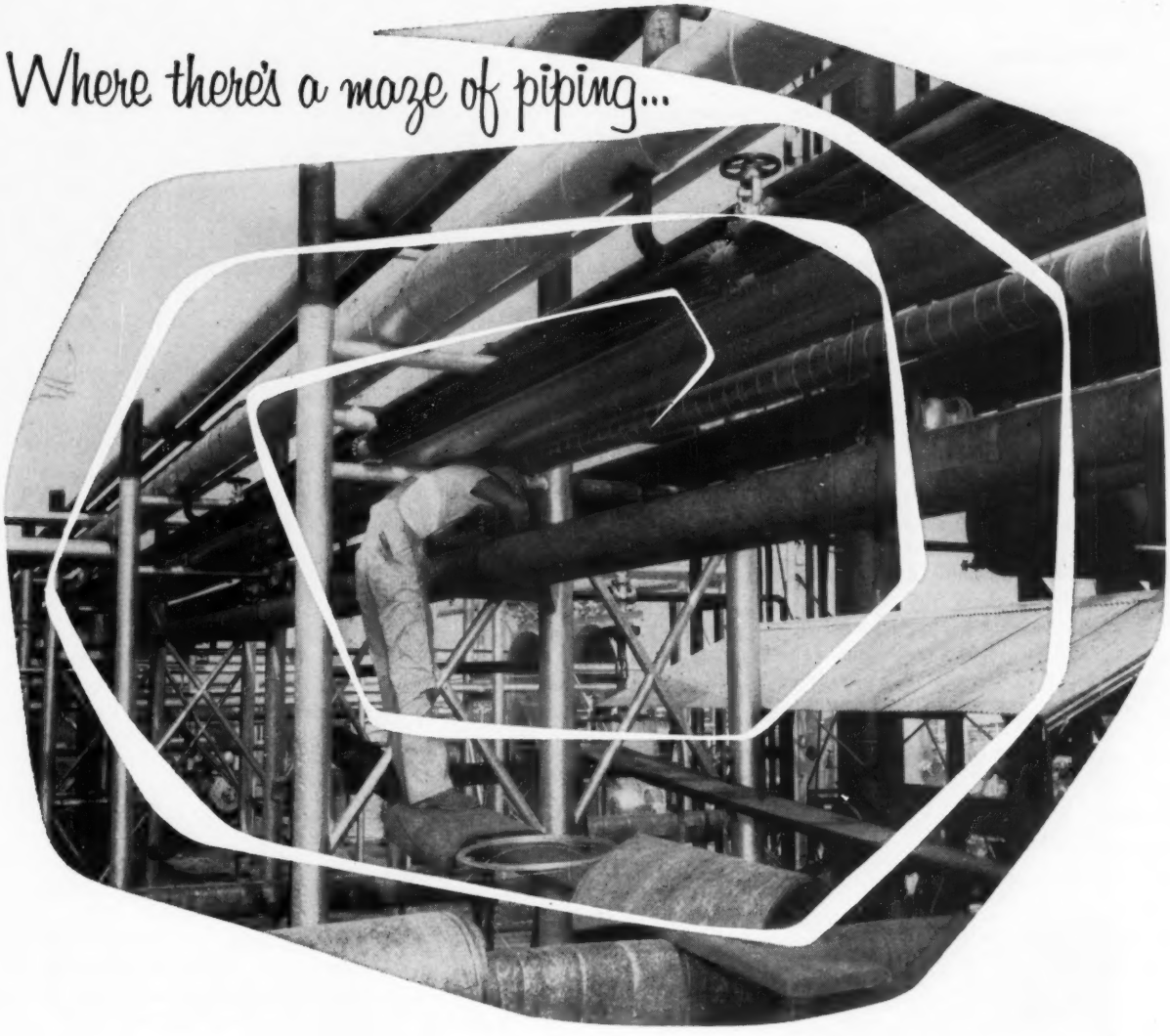
Two other new emulsifying chemicals are Witco DGO, a diethylene glycol oleate for latex and resin emulsion paint systems, and Witco GMO, a glyceryl monooleate for dispersing alkyd resins in odorless paint systems.—**Witco Chemical Co., New York 17, N.Y.** **146B**

Fire Extinguisher

No carbon monoxide or phosgene formation during fire-fighting.

"Azeotropic chloromethanes" have found their way into a fire extinguishing formula called CM-7, a product of Beall Research and Engineering Corp., Washington, D. C. CM-7, it's said, is superior

Where there's a maze of piping...



...there's an amazing saving with SNAP*ON

With reports of savings from 20 - 50% on new G-B Snap*On pipe insulation, you can readily understand the enthusiastic reception it receives in refineries, natural gasoline plants, petrochemical and chemical processing plants.

Ease of applying these one-piece molded cylinders of fine glass fibers is the key to such substantial savings. Unlike segmental insulations, Snap*On comes in 6' sections, in sizes as large as 33", and is easy to apply even in crowded quarters.

For in-plant use, Snap*On is available plain or with canvas adhered for heated piping where temperatures do not exceed 350° F. and with adhered vapor jackets for chilled piping. For outdoor service, simply snap on Snap*On and cover with weatherproofing materials.

The bigger your plant, the bigger your savings when you use G-B Snap*On. You save on original installation . . . you save on maintenance, because Snap*On is rugged and permanent . . . you save heat, because Snap*On is superior in thermal efficiency to any similar product on the market.

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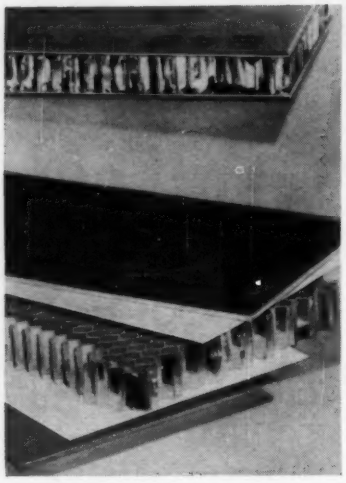
252 W. 10th St., Kansas City, Mo.

to vaporizing liquid fire extinguishers like carbon tetrachloride and chlorobromethane. Neither phosgene nor carbon monoxide can form when CM-7 is applied to a fire.

Other claims: (1) CM-7 produces 10-20% more vapor than CCl_4; (2) penetrates burning embers of wood, textiles and other Class A fires more deeply than any other vaporizing liquid on the market today; (3) fights fire in three phases: a flash-fog generated before fluid reaches the average boiling point of its components, 152 F.; then, a dense, penetrating blanket formed as the bulk of the CM-7 vaporizes; and finally, a residual fog, as the remainder of the CM-7 boils away, to smother any re-ignition or flashback of fire.—**Red Comet, Inc., Littleton, Colo.** 146C



Adhesive

Gives 40 lb. per in. peel strengths, 2,000 psi. tensile shear strengths.

Plymaster V2, a glass mat supported adhesive film, can be cut in special shapes for specific applications, saves time and labor costs in metal to metal and metal to plastic bonding. Adhesive pickup on reinforcing glass mat base is about 5 oz. per sq. yd.

One of Plymaster V2's chief uses is for bonding metal skins to paper or to metal honeycomb cores in sandwich construction. (Cut shows aluminum facing bonded to aluminum honeycomb core which, in turn, is bonded to aluminum facing.)

Other flat surface bonding pairs: vinyl sheet to steel; reinforced plastic decorative laminate to aluminum; rigid phenolic or polyester sheet to metals.—**Rubber & Asbestos Corp., Bloomfield, N. J.** 148A

Chlorinated Polymer

Performs on a par with more expensive materials.

Polypenco K-51, a chlorinated polymer, provides the fabricator and user of chemical processing equipment with properties possessed only by more costly materials such as the fluorocarbons.

• Superior resistance at room and boiling temperatures to hydrochloric, sulfuric, nitric and chromic acids; acetone; ammonium hydroxide; ethylene dichloride; toluene; hydrogen peroxide, etc.

• Virtually zero water absorption and, therefore, good dimensional stability.

• Useful above 250 F. in non-oxidizing atmospheres; parts used in oil at 320 F. for eight months without failure.

• A heat distortion temperature in the same class as FM 10001 nylon (185 F. for 264 psi. load; 300 F. for 66 psi. load). A thermal coefficient of expansion less than that of fluorocarbon plastics.

• Tensile strength at 73 F.: 6,000 psi.; Rockwell hardness: R100. Harder and lighter than fluorocarbons available. Machineability is excellent.—**Polymer Corp. of Pennsylvania, Reading, Pa.** 148B

Briefs

A new concept in insect control—indirect destruction—is possible with many substances which, although "non-toxic," can inhibit the normal development of insects and eventually cause their death. One of these chemicals, piperonyl butoxide, is normally added to insecticides to boost their effectiveness; alone, however, it slows down the rate of housefly larvae development, prevents many from becoming adults, particularly those that are DDT-resistant.—**U. S. Dept. of Agriculture, Washington, D. C.** 148C

Three new organic intermediates now in commercial production are benzyl ethylene oxide, 1-chloro 3-phenyl-2-propanol and benzyl ethylene glycol. Mercapto and sulfone derivatives of these compounds may prove of value as synergists and biocidal agents. Chlorinated amino alcohols should also be of interest. Benzene ethylene oxide is suggested as a stabilizer for chlorinated hydrocarbons and as an active diluent for epoxy resins.—**Millmaster Chemical Corp., New York 36, N. Y.** 148D

Fluorochemicals can reduce acid mist and spray from chromium plating baths, the only class of effective compounds which, it's said, is not affected by the highly oxidizing conditions in a chrome bath. Zero-Mist pellets, incorporating a Minnesota Mining and Mfg. Co. fluorochemical, lay a yellow foam blanket on the surface of a chrome bath. Chromic acid waste is cut as much as 70%, with a 50% cut in dragout losses.—**Udylite Corp., Detroit, Mich.** 148E

Dibutyl fumarate is now available in quantity. A good deal more active monomer than the corresponding maleate, dibutyl fumarate can produce polymers varying from hard, brittle resins to soft, internally plasticized, elastic materials. Copolymers with vinyl acetate are said to give outstanding results in emulsions for water paints.—**Borden Co. Chemical Division, New York 17, N. Y.** 148F

Formaldehyde isn't "Formaldehyde" any more

It's one of 4 specialized types—designed to meet specific needs—and only Celanese supplies all 4

Suppose you're producing a low solids resin for plywood adhesives. Celanese* Formalin (37% formaldehyde in water) is your best bet. On the other hand, for a high solids urea resin, your Celanese representative can show you conclusive reasons why Celanese Paraformaldehyde (flake 91% active chemical), with its high reactivity, is your most efficient and economical source for formaldehyde.

Many producers of alcoholated resins have discovered that a Celanese Formcel* Solution of formaldehyde in a specified alcohol eliminates a costly step in the production cycle. Or, if you're looking for the most readily available source for dry formaldehyde gas, you'll want Celanese Trioxane, the anhydrous formaldehyde.

The right formaldehyde can give you the competitive edge—through lower production costs and higher product quality. Celanese—formaldehyde headquarters—can help you make the right choice.

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Chemical Division, Dept. 553-1
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CHEMICALS

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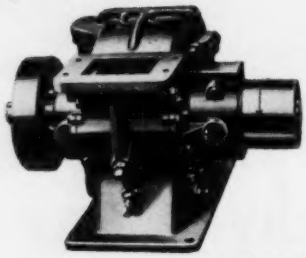
Laboratory Equipment...

assures accurate samples... cuts laboratory sampling costs

Sturtevant laboratory equipment have all the features of full-sized production machines with extra accuracy and wider range of adjustment built-in. They are fast... provide true samples of every batch processed.

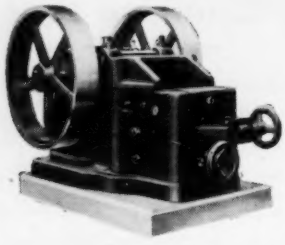
All Sturtevant machines have "open-door" accessibility which permits quick, thorough cleaning... prevents the possibility of previous batches from contaminating new samples. Their rugged construction assures round the clock operation with practically no maintenance.

Investigate Sturtevant equipment for your laboratories. They will help you cut sampling costs... improve product quality... increase sales. Write for catalog, today.



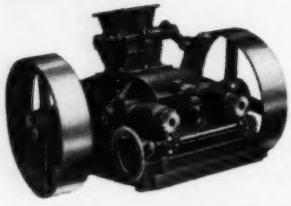
LABORATORY SWING-SLEDGE MILLS

Capable of reducing soft, moderately hard and tough or fibrous materials to any degree of fineness between 1 in. and 20 mesh. The patented "Open-Door" feature permits ready accessibility for cleaning.



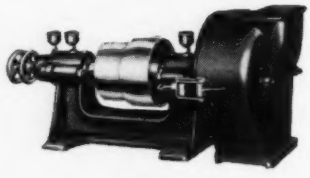
LABORATORY JAW CRUSHERS

Special Roll Jaw action simplifies close regulation of the product with capacities varying from 300 to 400 lbs. per hour at finest settings, to 1000 or 2000 lbs. when opened for coarser work. Each part of the crusher is accessible for quick and easy cleaning.



LABORATORY CRUSHING ROLLS

First designed especially for laboratory sampling work, Sturtevant Crushing Rolls are used regularly in many plants where there are limited out-puts. Range of output for the 8 x 5 size is from ½ in. to 20 mesh — and for the 12 x 12 size from ¾ in. to 20 mesh.



LABORATORY SAMPLE GRINDER

Laboratory Sample Grinders are of the "Open-Door" disc type and are capable of very fine work, producing products as fine as 100 mesh (coarser if desired) when working on dry, friable, soft or moderately hard materials. Simply turn hand wheel to provide product regulation from 10 to 100 mesh.

STURTEVANT MILL COMPANY

100 Clayton Street, Boston 22, Mass.

Designers and Manufacturers of

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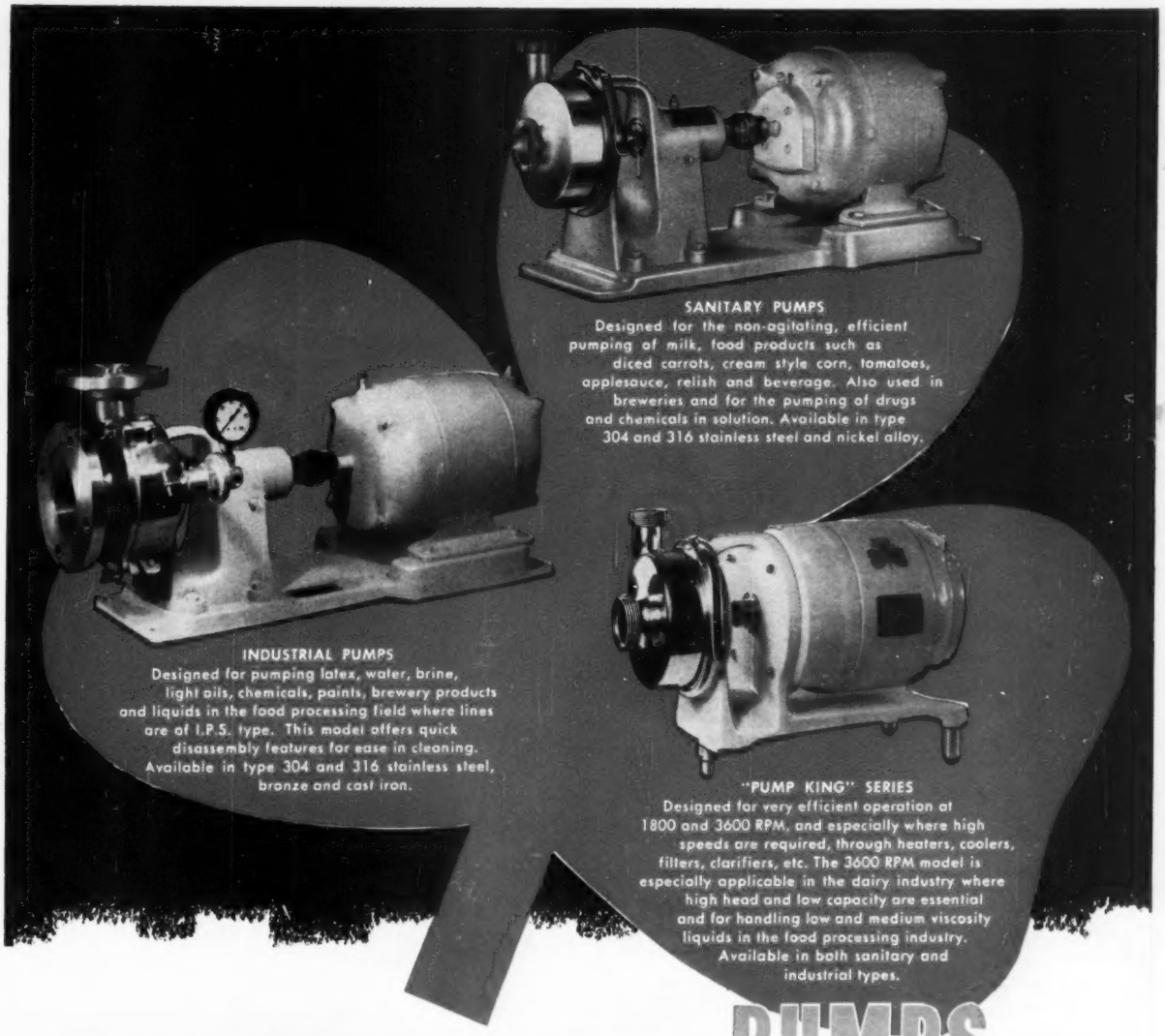

SANITARY PUMPS
Designed for the non-agitating, efficient pumping of milk, food products such as diced carrots, cream style corn, tomatoes, applesauce, relish and beverage. Also used in breweries and for the pumping of drugs and chemicals in solution. Available in type 304 and 316 stainless steel and nickel alloy.

INDUSTRIAL PUMPS
Designed for pumping latex, water, brine, light oils, chemicals, paints, brewery products and liquids in the food processing field where lines are of I.P.S. type. This model offers quick disassembly features for ease in cleaning. Available in type 304 and 316 stainless steel, bronze and cast iron.

"PUMP KING" SERIES
Designed for very efficient operation at 1800 and 3600 RPM, and especially where high speeds are required, through heaters, coolers, filters, clarifiers, etc. The 3600 RPM model is especially applicable in the dairy industry where high head and low capacity are essential and for handling low and medium viscosity liquids in the food processing industry. Available in both sanitary and industrial types.

These efficient Tri-Clover PUMPS can pump any product that will flow to them . . .

ANY product that will flow to them can be handled efficiently and economically with Tri-Clover non-agitating centrifugal pumps. Illustrated are just three of the many Tri-Clover pump models used extensively in food processing, brewing and bottling, chemical process and general industrial applications. Pumps are available in stainless steel, nickel alloy, bronze and cast iron.

Designed for efficient liquid transmission and low cost maintenance, these pumps have many exclusive features, among which are—patented screw type impellers with quick-acting impeller clips, lightweight heads with a minimum of parts, casing construction permitting fast, easy assembly or disassembly—and a wide choice of seals for various applications, including inert carbon rotary seals for sanitary application, packing gland seals, water cooled seals and seals for latex handling.

Tri-Clover's exclusive developments are the result of many years of specialized engineering experience and thorough knowledge of liquid handling. Let our engineering staff work with you in solving your pumping problems.

SEND FOR THE TRI-CLOVER PUMP CATALOG — ***One of the most complete, useful pump catalogs ever compiled. Contains engineering data on all types of pump applications. Write for your copy of Catalog 253 today.***

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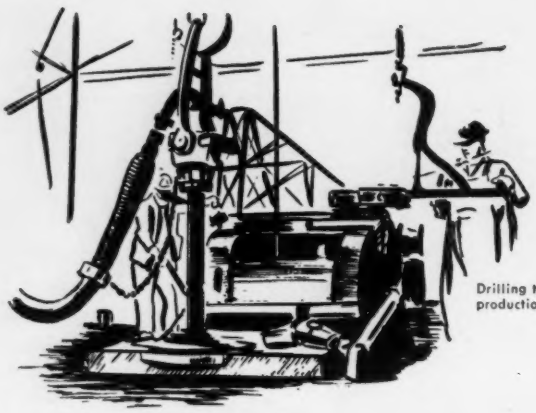
Drilling the production wells

Crude Sulphur

for Industrial Use

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Producing Units

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- **MOSS BLUFF, TEXAS**
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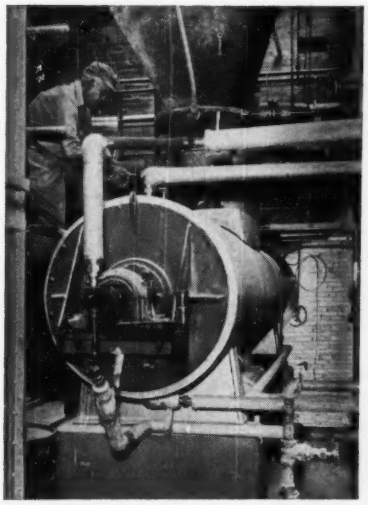
- **WORLAND, WYOMING**

G-11® (brand of hexachlorophene) is dried uniformly to less than 1% moisture content in Stokes rotary vacuum dryers

STOKES rotary vacuum dryers vital to processing of G-11®

Sindar product dried at low temperatures on round-the-clock production schedule.



Two Stokes rotary dryers run 24 hours a day at the Givaudan plant in Delawanna, N. J.

In the fight against bacteria, G-11® (brand of hexachlorophene), developed by the Givaudan Corporation and marketed by its associate, Sindar Corporation, is doing for the skin what antibiotics are accomplishing in internal medicine. From an initial application in operating room "scrub-up" soaps, the product has found ever-widening application in cosmetics where its unique "cleanliness that clings" gives valuable antiseptic and deodorant qualities to creams, lotions and soaps.

Because of the need for low-temperature drying, laboratory and pilot-plant investigations with G-11® were carried out in Stokes vacuum shelf dryers. To meet the growing demand for this product, two Stokes vacuum dryers now operate 24 hours a day.

Stokes has had vast experience in the design and application of chemical processing equipment. Your particular problem will receive careful consideration, based on this broad background.

For an informative brochure on Vacuum Drying, write for Catalog 720. For complete information on how the Stokes Advisory Service and Laboratory can help you, send for Bulletin 640.

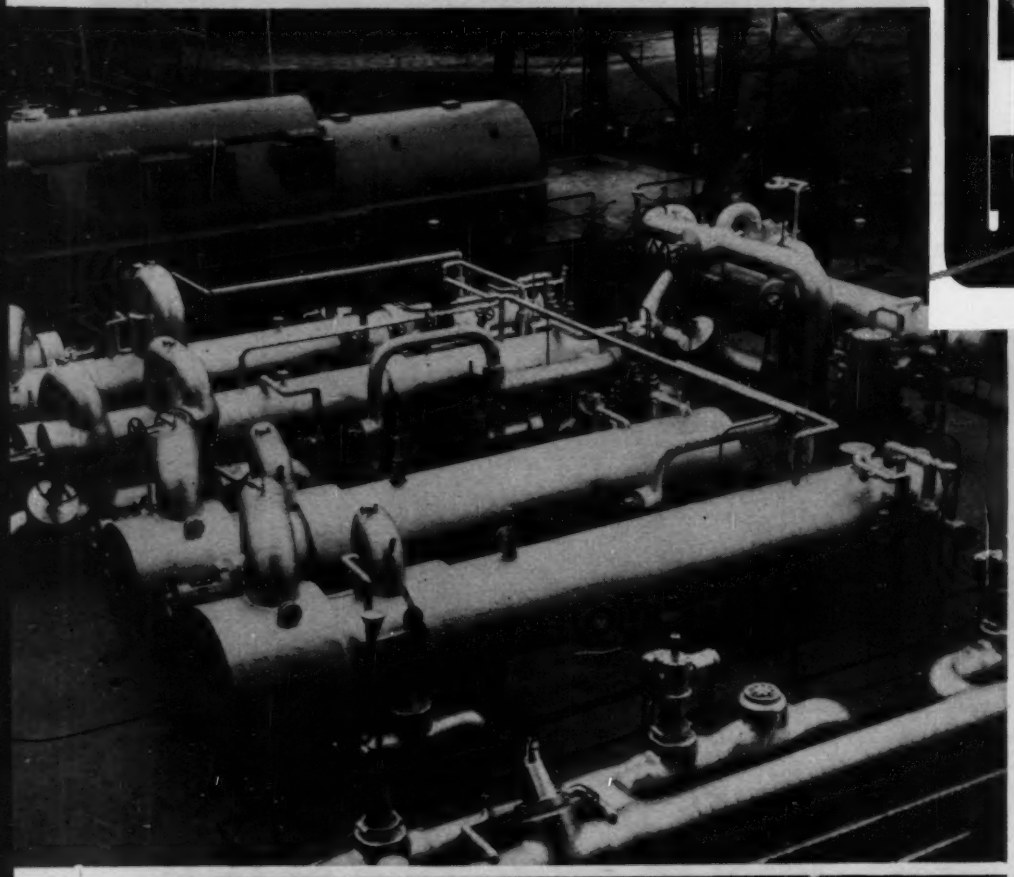
F. J. Stokes Machine Company, Philadelphia 20, Pa.

OFFICES IN PRINCIPAL CITIES, REPRESENTATIVES THROUGHOUT THE WORLD

STOKES

One of a series telling
how the producing companies of
General Precision Equipment Corporation
are contributing to America's progress.

GPE



Griscom-Russell feed water heaters in a 125,000 KW public-utility power station; save nearly 100 tons of coal per day. Heaters handle flow of water exceeding 2000 G.P.M. at 2500 pounds pressure and steam extracted from the turbine at five different points; "train" of five units preheats water fed to boilers from 90° F. to 441° F.

Askania multiple fuel boiler control panel in large steel plant; maintains metered proportion between combustion air and fuels—coke oven gas and fuel oil—for most economical combustion; holds steam pressure constant through all load changes and keeps furnace pressure at a safe and predetermined value.

General Precision Laboratory's Industrial TV Camera, the "Bullet"; portable, easily operated; used to monitor and improve manufacturing processes and to view hazardous industrial operations.

The highly advanced technological products designed and manufactured by the eighteen producing companies of General Precision Equipment Corporation serve more than a dozen major industries. Products of six of these GPE Companies—Griscom-Russell, Askania, Librascope, Link, Kearfott and General Precision Laboratory—have widespread application in the processing and power industries.

Industrial Processing...and Power

The Griscom-Russell Company is one of the country's largest producers in the fields of heat exchange and water distillation. It is the pioneer in heat exchanger equipment—the key to the whole complex of modern industrial processing and power. For over seventy years, G-R equipment has been responsible for greatly increased efficiency and lowered operating costs in industry.

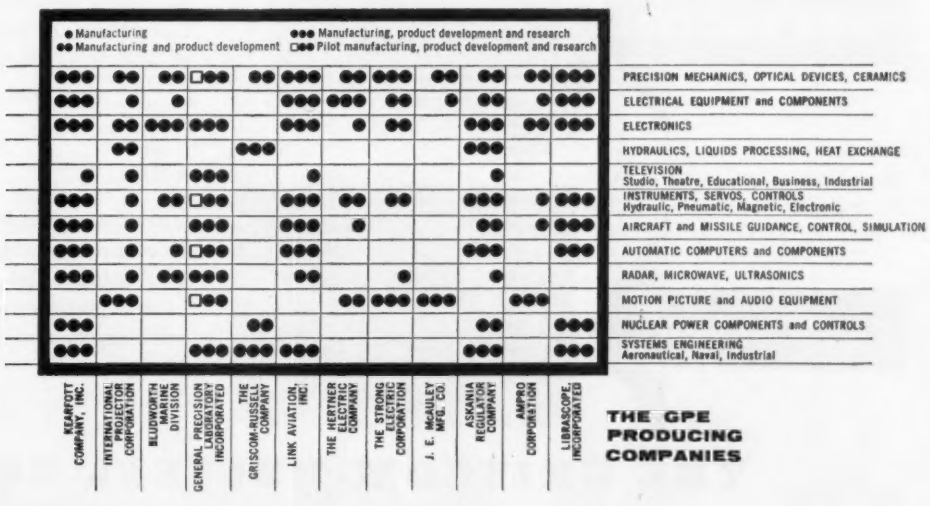
Askania Regulator Company for a quarter of a century has been a leading developer in the field of regulators and controls, including components and systems. Its products are widely used by the power, steel, gas and coke, mining, chemical, petroleum, glass and paper industries—wherever great reliability and accuracy are essential.

Kearfott Company, Inc.; Librascope, Incorporated; and Link Aviation, Inc. produce a wide variety of precision instruments, computers, servos and other control components for equipment and systems used throughout the power and the processing industries. Industrial television equipment manufactured by General Precision Laboratory Incorporated, the sixth GPE Company active in these fields, is playing increasingly important roles in "seeing eye" monitoring operations in these industries.

Each company in the GPE Group works in specific, highly specialized technical areas, as indicated in the chart below. Each of these companies, in addition to specializing in its particular products and fields of technical competence, has at its command, as required, the facilities and specialized techniques of the other GPE Companies in their respective fields. Interrelation is achieved through GPE's basic operating policy, Coordinated Precision Technology.

In the fields of research and development, GPE Coordinated Precision Technology permits a high degree of specialization in particular areas of competence and supplements such specialization by the application of techniques in other fields, as desirable. In the field of production, it makes possible a highly flexible application of facilities. This policy has been responsible for a diversified line of precision equipment of superior design and performance, covering a wide range of both standard and special uses.

Perhaps the most conspicuous advantage of GPE Coordinated Precision Technology is that the concept and development of equipment, and of solutions to the underlying technical problems, are not restricted or distorted by traditional allegiance to specialization in a particular field. GPE coordination permits the engineers and technical personnel of each GPE Company to seek the optimum solution for the customer within the total capacities of the GPE Companies as a group.



A brochure relative to GPE Coordinated Precision Technology and the work of the GPE Companies is available. Address your request, or inquiries on specific problems, to:

General Precision Equipment Corporation

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G-R fin-fan ...

from every point of view...

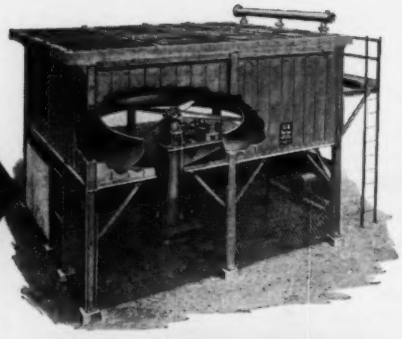
top value in **Air-Cooled Heat Exchangers**

G-R **fin-fan** is top value in air-cooled heat exchangers because of the *experience* behind this unit. This experience includes 85 years of building heat transfer apparatus, 25 years of specializing on extended heat transfer surfaces as used in air-cooled exchangers, the operating records of hundreds of **fin-fan** installations all over the world, and the results of thorough tests on every element of the unit.

FROM ABOVE

The K-Fin Sections which form the heat transfer surface are used only in the G-R **fin-fan**. Many millions of square feet of this exclusive helically-finned surface are being used in more types of air-cooled services than any other design.

FROM THE SIDE



The strong reinforced construction is built to withstand wind pressures of more than 40 lbs. per sq. ft. The pre-fabricated, pre-drilled structure is specifically designed for speed and convenience of erection and connection to additional units.

FROM BELOW

Drive mechanism for G-R **fin-fan**. Note the mounting of driving motor and gear reducer, the powerful fan of proven performance, and the smooth bell ring for maximum aerodynamic efficiency.

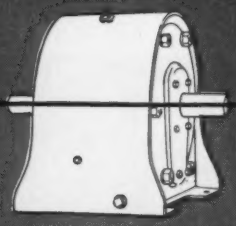
REG U.S. PAT. OFF.

THE GRISCOM-RUSSELL CO.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

MASSILLON, OHIO

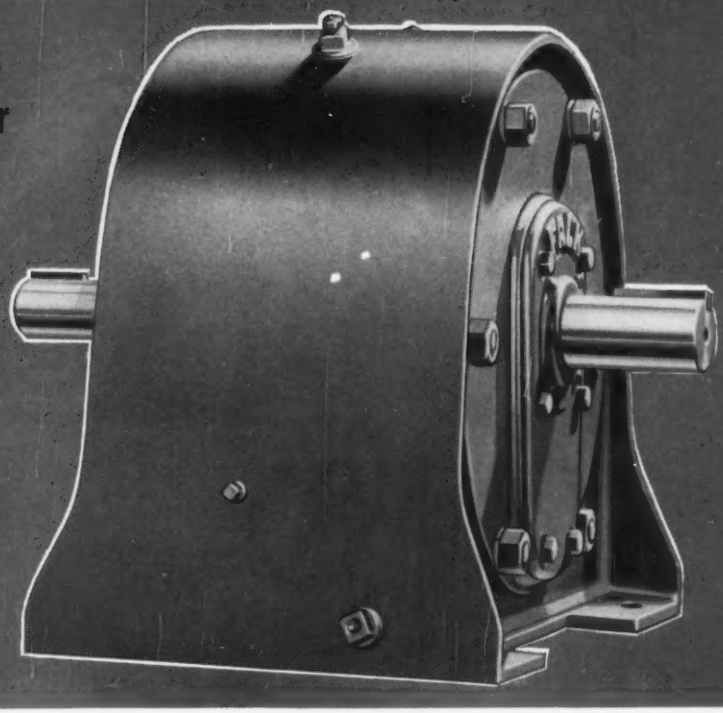
The versatile, STRAIGHT LINE

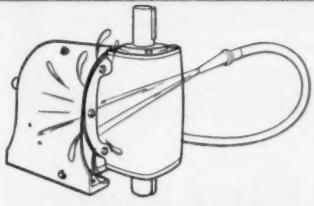


ALL-STEEL FALK SPEED REDUCER

(Concentric Type)

High and low speed shafts suitable for V-belt, gear or chain as well as coupling connections





The Type "C" Speed Reducer has these "In-built" Factors:

Sealed Housings. Dual closures and one-way vents keep oil in, dust and moisture out. Units are splash-proof, leakproof, dust-proof.

Positive Lubrication. Large sump capacity . . . oil-tight construction assures clean lubricant . . . direct dip of revolving elements provides positive lubrication at all speeds.

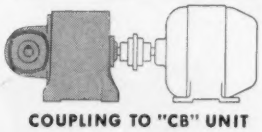
Precision Gearing. Heat treated alloy steel, precision cut and shaved helical gearing throughout . . . quiet-operating crown shaved pinions . . . taper bored gears for easy ratio changes.

Wide Speed Range. Selective ratio combinations provide output speeds from 1.5 rpm to 1430 rpm with stock gears.

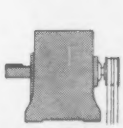
All-steel Housings. Unbreakable, strong, rigid. Generous overhung load capacities provided by wide bearing spans, large shafts and bearings.

Streamlined inside and outside. Smooth, clean surfaces; machine welded construction conforms to NEMA motor frames.

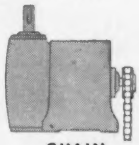
A FEW TYPICAL DRIVES FOR "C" AND "CB" UNITS



COUPLING TO "CB" UNIT



V-BELT TO "C" UNIT



CHAIN TO "CB" UNIT

Write for Bulletin 1104

The ideal type for Turbine, Engine or Special Motor

Here is an exceptionally versatile member of the famous FALK line of reduction units. The Type "C" Straight Line Speed Reducer is an all-steel concentric shaft unit rated in accordance with AGMA standards. It is structurally similar to the universally popular FALK Motoreducer, and offers many special application advantages.

It can be driven by motor, turbine or engine with direct coupling connection—or through a V-belt or chain drive. It lends itself effectively to hydraulic coupling, brake-wheel or overload protective coupling, multi-speed transmission, or to variable speed drives—without modification. Units can include self-contained backstop if desired. Ratio can be modified with easily installed stock gears. With modifications, unit can be used as a speed increaser.

These all-steel Straight Line Speed Reducers are *available for prompt delivery* in standard ratios in horizontal and vertical concentric models, also in horizontal and vertical right-angle models; in single, double, triple and quadruple reduction. For full details, write for Bulletin 1104.

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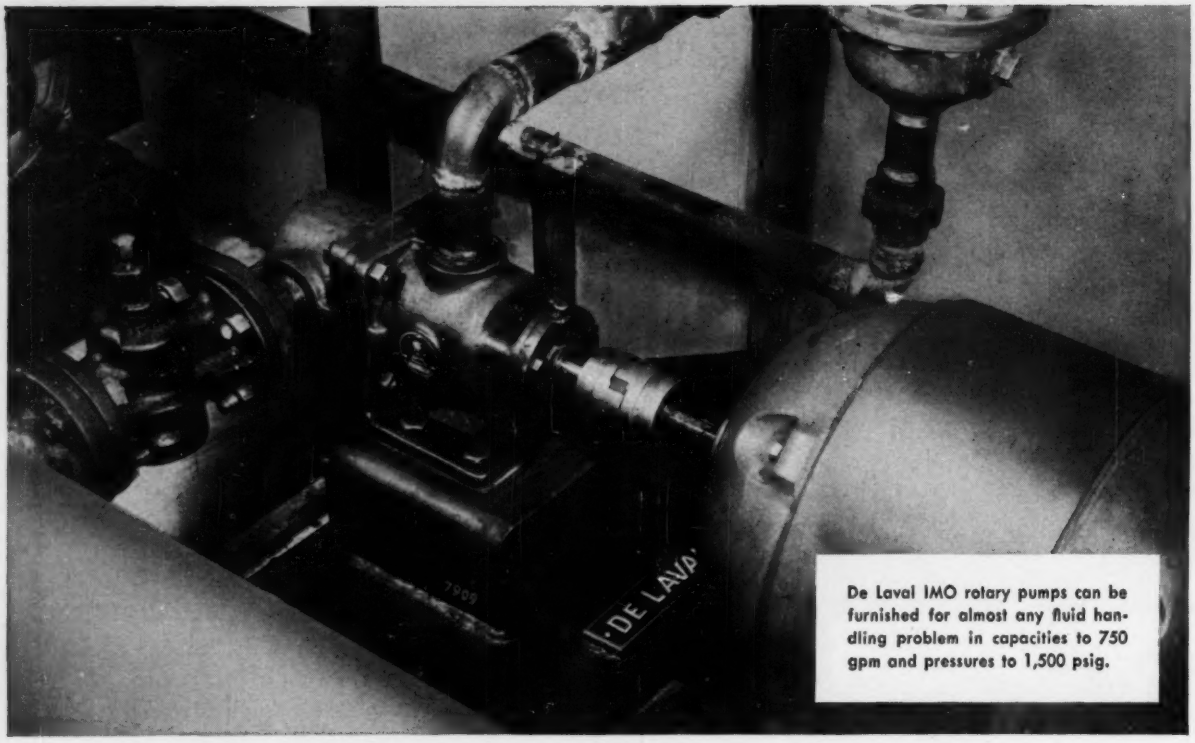


De Laval IMO rotary pumps can be furnished for almost any fluid handling problem in capacities to 750 gpm and pressures to 1,500 psig.

What to Look for in a Rotary Screw Type Pump

By W. J. MONCON, *Assistant Chief Engineer*
De Laval Steam Turbine Company

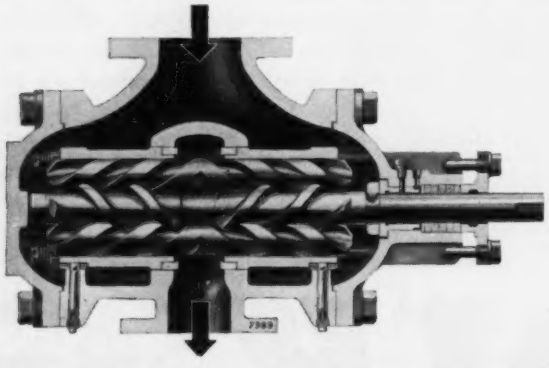
A sound knowledge of design, and how it affects performance, is the best insurance a buyer can have that he will get the pump he needs. This brief analysis of the IMO, a rotary three-screw pump manufactured by the De Laval Steam Turbine Company, will give you some of the necessary facts.

What qualities should you look for in a rotary type pump? It must, of course, meet specified capacities and pressures. But, it must also be efficient, operate quietly, stay on the job.

The axial flow of a screw type pump, and the resulting low inlet losses for any given pump speed, are important benefits that should be considered in making pump selections. The absence of timing gears and other mechanical features of construction also enable the De Laval IMO pump to operate at direct-connected motor and turbine speeds . . . to handle viscous liquids and high suction lifts.

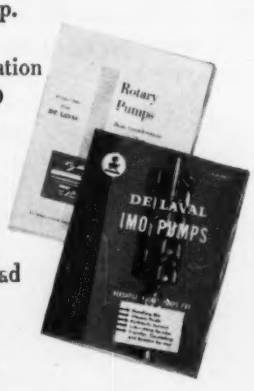
One of the most important features of the IMO pump is the hydraulic turning of the idler or sealing rotors. The central or power rotor is the pumping element; the liquid pumped turns the sealing rotors.

A screw type pump is well suited for applications where pulsation-free flow is desirable. The axial flow of the liquid without trapping and the unique thread form which keeps closures fluid-tight contribute to quiet operation of the IMO pump.



De Laval IMO Series A322A, a positive displacement, rotary screw type pump, can handle capacities to 750 gpm and pressures to 150 psig.

Catalog LS gives useful application and specification data on the IMO pump. An article titled, *Rotary Pumps, Basic Considerations in Their Application*, contains a description of rotary pumps in general. For these publications, write on your company letterhead to De Laval Steam Turbine Company, 803 Nottingham Way, Trenton 2, New Jersey. DL-301



What one tube steel will give you the best life/cost ratio? *Ask the experts!*

This month's report is on: **DM STEEL**

Has unusually high creep strength for a pearlitic steel, good stability up to 1200°F., fairly good corrosion and oxidation resistance. Has 2 to 3 times the life of carbon steel where corrosion is not severe. Recommended for cracking furnace tubes, hot oil lines, superheater tubes, high temperature steam piping and forgings for accessory parts.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

Carbon	Sicromo 2	Sicromo 5S	18-8 Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

**Available as seamless tubing on an experimental basis only.*
***Not available as seamless tubing.*

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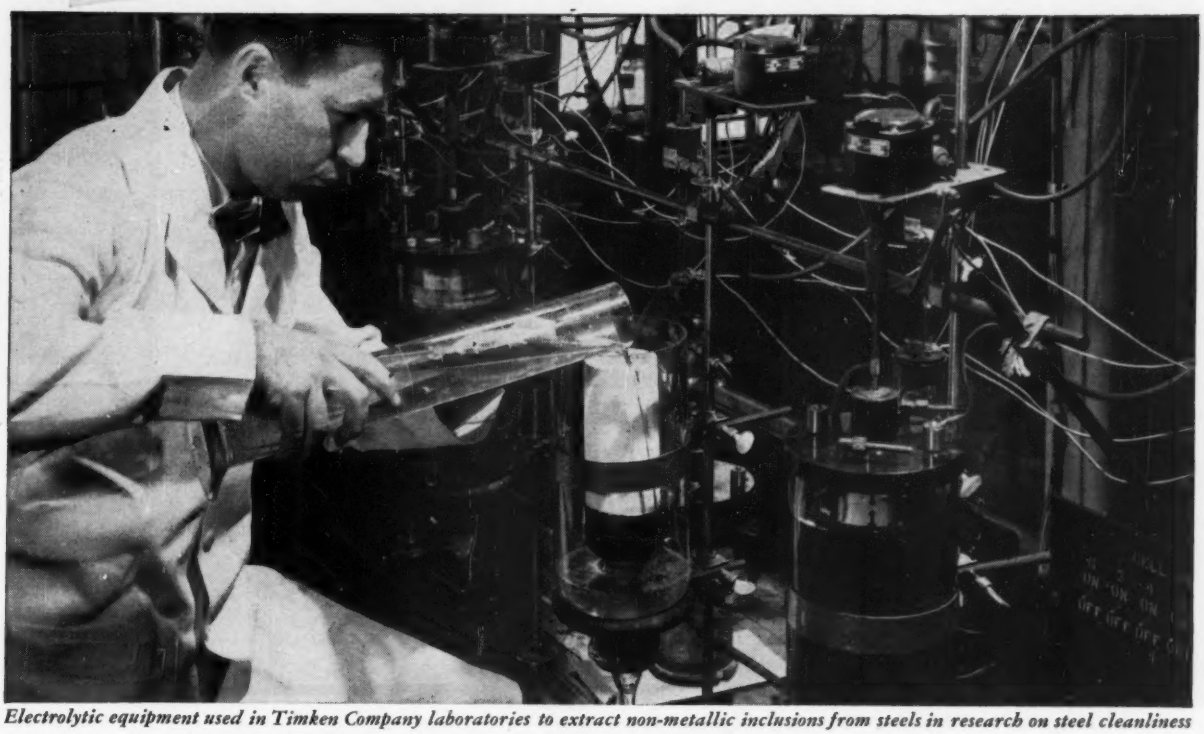

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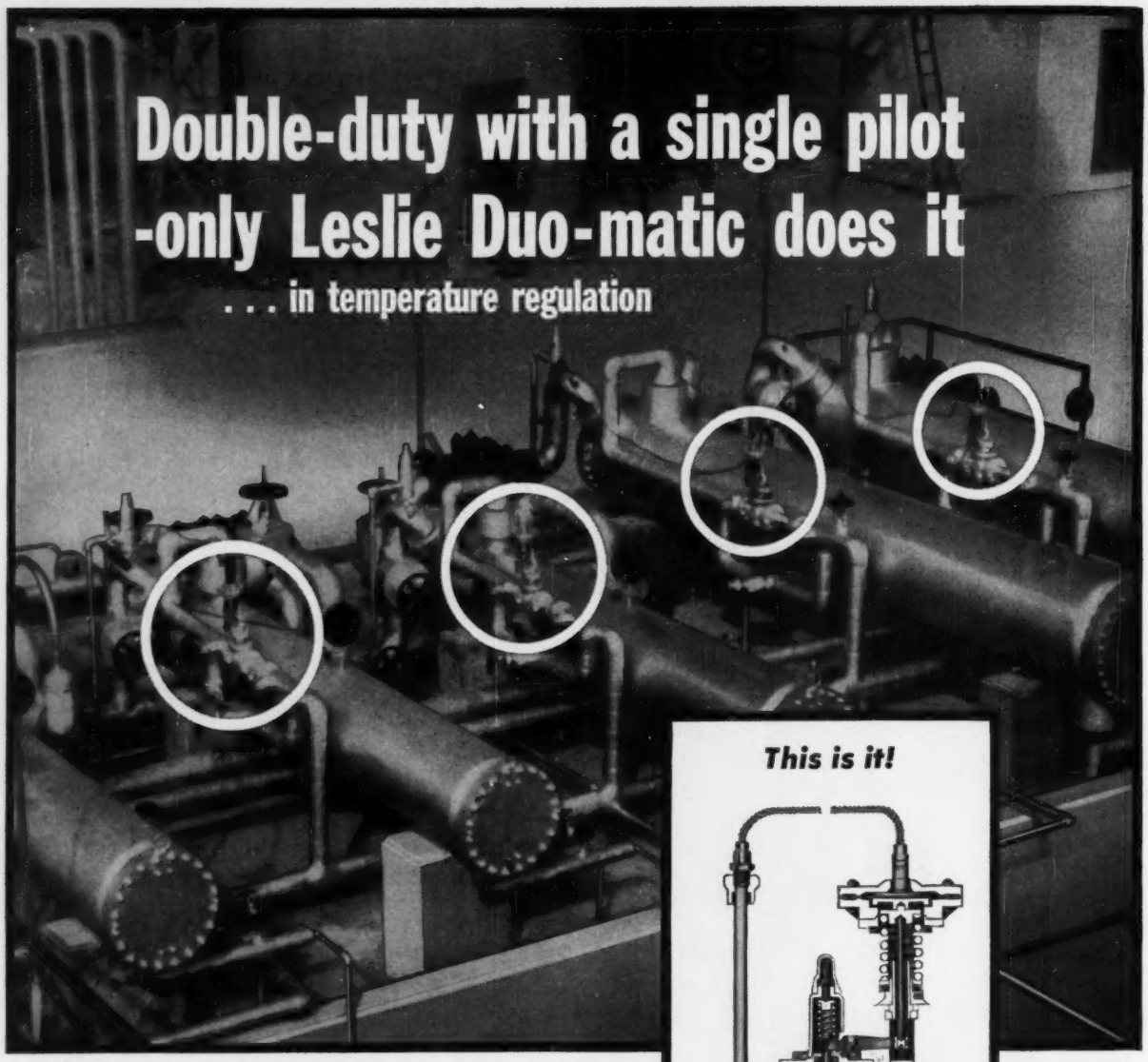

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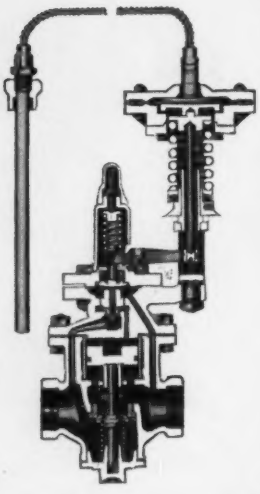

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Chemical Engineering SEPTEMBER 1955

Developing Yourself Professionally

You'll need goals—here's how to set them.
You'll need a route—here's how to map it.
You'll need help—here's where to find it.
You'll profit from doing it—here's how.

HUGH T. SHARP

To some engineers the term "professional development" means only a lot of bunk put out by management to get a good day-and-a-half's work for a poor day's pay.

And, at times, the words and actions of various management men tend to lend more than a little weight to this notion. But it usually happens that those who advance this theory turn out a good deal less successful than the men who defend working at professional development as the key to personal progress.

Investing time and effort in a planned program for professional development does pay off.

It pays off because professional development is essentially an extension of the process of growing up—an intensification of that process. It involves continued learning and the handling of ever greater responsibilities. And, since this is too important to be left to chance, it involves conscious effort.

What is the payoff? Part of it lies in the increased earning power that goes with an increased capacity for responsibility—you can do more, so you stand to make more. Another slice comes from the recognition and friendships you gain through your work and activities. And a big hunk of the return is in the form of greater personal enjoyment, satisfaction and a sense of achievement.

To Reap Reward, Invest Time and Energy

To develop professionally, a man must invest time and energy. His rate of growth depends primarily on his capabilities, his own efforts and how early in his career he starts developing his potential. Others, of course, can help and can provide facilities, but they can't set your goals for you and they can't attain them for you. The problem of your professional development rests squarely in your lap—to be brushed off or worked on as you will.

Setting career goals and mapping a method of gaining them isn't an easy task for any engineer—especially for one fresh from the campus. There are too many uncertainties. Take the draft for one. Realizing that next year or even next week can signal the start of a 24-month interruption, can wet-blanket all thoughts of mapping a career.

But once plans for professional development are sidelined, it's an ominous sign that progress is due for a slump. The growth which characterized the engineer's college years too often ends when he finds industry assigning him to routine technical jobs, and so he goes on to make a career of such mediocre assignments. In short, he lands in a rut.

Although a fair amount of routine, noninspiring jobs comprise the start of most engineering careers, the young engineer shouldn't be bulldozed into thinking that a succession of such assignments is all he has to look forward to. The early launching of a sound scheme for professional development, despite the uncertainties, can pull you out of this rut.

A prime reason for the high rate of development in college lies in the fact that you had a goal (your degree), a means of getting it (classes and studies) and a way to measure your progress (tests and examinations). Now, it's up to you to give yourself such an objective and dope out your own way to attain it and to tell how you stand.

Set Two Goals for Yourself

Though it's far from easy to set realistic career goals in view of the many imponderables which must of necessity be pondered, there's at least one workable technique worth trying. It involves setting two distinct

HUGH T. SHARP, *a chemical engineering graduate from Villanova University, edits the You & Your Job department in* Chemical Engineering.

objectives; one of the "dream" variety and the other practical and relatively easy to attain. On the first put no time limit; tack a rigid deadline on the second.

For instance, suppose a newly minted ChE decides to aim for vice president for research and development. He sets no time limits on attaining this—any old time would be good enough for him. But for his second objective it's a far different story. He rates his capabilities and his willingness to work on developing them and aims for a specific post, say, group leader at a definite time, say, five years.

This method has a sound psychological grounding. One goal reinforces the other. The former insures that the reach will be longer than the grasp, the latter gives you a chance to measure the return for your effort and to rate your progress.

For optimum effect, the distant goal should be one you do have an opportunity to reach—even if it's as small as one in a thousand. Your chances of attaining your other objective should be more nearly one in ten or so. For the latter a deadline of five years is about the limit. Especially in the beginning, two or three years would be preferable.

Take a fresh look at these goals and your progress toward them about once a year, and hold a full-fledged review every five years or so. These checks form vital parts of any program for professional development and we'll dwell on them a bit later.

Mapping the Route to Your Goals

After fixing goals, it's time to tackle the task of mapping a route to them. This takes some canny thinking and can prove both absorbing and a lot of fun. The procedure is simple, though little else about it is.

Examine and analyze both goals, determine what they require in the way of personal and professional qualities, rate your capabilities against the needs and decide on how to fill the gaps which show up.

In your analysis, keep in mind that both times and jobs change in tenor with the years. For example, today's typical manager needs far more technical and managerial training than the manager of 20 years ago. Will tomorrow's executive need training not widely given now? In the same way, will the impact of nucleonics, automation, etc., require revamped thinking on the engineer's part?

Maybe a miscalculation here won't mean too much in view of the many other uncertainties involved, that's your decision to make. But a steady reading of the work of forward looking thinkers in science, business and society will help you learn what to look for.

Here's Help in Mapping

In routing a path to your goals, you will find the six-point program prepared by the Engineers' Council for Professional Development worth considering. ECPD urges engineers to view any personal program in the light of development opportunities in each of these areas:

Don't expect too much from a company training program. If you think you've found a good one, by all means get all the help you can from it. But realize that it won't come close to doing the whole job.

- Industry orientation and training.
- Continued education.
- Integration into the community.
- Professional identification.
- Self-appraisal.
- Selected reading.

These areas hold opportunities to be exploited in mapping your career—but they also contain a few problems for you to solve.

Opportunities Bring Problems

For example, the first of the above, orientation and training in industry, falls as much in the employer's lap as in the engineer's. And most companies have learned that a worthwhile training plan, which introduces the newcomer to the company's policies, products and people and which helps him find and become proficient in the job which suits him best, benefits all concerned.

But the great variety of such programs gives the young engineer the difficult problem of picking a good one. When taking or changing a job, or when evaluating the merits of plans in his own company, the task of rating a training program is pretty rough.

A good way, probably the only practical way, to size up a training plan is to ask questions. But don't bother asking anyone in the company in a post of authority if the program is any good. Almost automatically, they'll proclaim its success.

Instead ask to see outlines, training schedules, training materials; ask about the program's graduates, what they are doing now, what their prospects for further advancement are, how many have left the company, why did they go, how soon after completing the program did most of them leave, etc. Then request the opportunity to speak to one or more of the program graduates. From him you'll probably get a clearer insight into the actual workings of the plan and its value than you would from anyone else.

Whether It Has a Program or Not

Last spring the Professional Engineers Conference Board for Industry working with the National Society of Professional Engineers poked into all phases of engineer training in industry* and concluded that too

* For a discussion of the study, its findings and recommendations, see *Chem. Eng.*, June 1955, p. 268.

Periodically, take a fresh look at your goals and your progress toward them. The more often you check and redirect your development plan, the better you'll be able to keep it on the beam.

little attention is paid to the engineer's professional growth. PECBI pointed out that although both large and small companies insist that their programs aim to help the engineer grow professionally, few really do.

So don't expect too much of a training program. If a particular plan appeals to you and you think it's a good one, by all means get all the help you can from it. But realize that it won't come close to doing the whole job. In the end, whether a man starts his career with a company boasting a training scheme or not, his growth will be largely in his own hands—where it belongs.

Company-run plans can assist, but they can't substitute for a personal plan. It still remains for the individual to stay alert and inquisitive, to invest some time in learning about his company and its operations and to ask pertinent questions about the work of his own and other departments.

This Isn't Simply Important, It's Vital

Industry orientation and training, then, presents both an opportunity and a problem.

So does continuing your education. This is not just important to development, it's vital. This is what professional development is all about. The professional man is characterized by his competence in his field, by his intellectual curiosity and by his willingness to spend some time and effort for the benefit of others.

Continued education carries opportunities to become more proficient in technical and business practice, to keep information updated, to build a firmer base on which to join studies of scientific and engineering principles and the humanities with practical experience. Time and distance are the major problems to be licked.

As far as formal education is concerned, it's best to get started as early in a career as possible—before greater responsibilities crowd in and hike the premium on time. Company aid in defraying tuition is common practice and a real help in continuing educations.

Often the time-distance duo proves too formidable and knocks out all thoughts of going on with formal studies. Correspondence and extension courses, company-run courses, technical and other thoughtful books and magazines can step in, however, and help you keep up-to-date.

These means, of course, are well known and appreciated, but a few others, not so keenly appreciated, can also help you continue your education. Such activities as technical committee work, writing articles and book reviewing combine both opportunities and incentives for keeping your knowledge current.

Work on a technical committee yields the added dividend of giving you a chance to rub elbows with experts in the committee's field.

Writing, whether articles or book reviews, serves the two-fold aim of helping you learn and boosting your prestige. Preparing technical articles can be a lot of work, but it can also spur you in keeping up-to-date in your field, and the criticisms and comments on your work from your editor can help you polish your writing skill.

Book reviewing holds similar advantages. While publications usually send review copies of books to currently recognized authorities on the subject, most would welcome the opportunity to add another name to their list of potential reviewers. You'll then have a strong incentive to keep your knowledge of the subject up-to-the-minute, as well as occasions to bring yourself to the attention of others in the profession.

Development Also Begins at Home

Another vital aspect of professional development involves the engineer's integration into his community. Admittedly, this rarely holds the financial lure of some of the other phases. It's much easier to see the payoff associated with developing competence in your field and giving a free rein to your intellectual curiosity.

But becoming a valued part of your community and taking on your share of civic responsibility does yield a return—albeit more subtle. Recognition, respect, friendships, personal enjoyment and satisfaction are all parts of it.

To take part in community affairs it's not necessary to get involved in politics. Although if you enjoy that type of activity, you'll have plenty of chances to do a lot of good. But there's a good deal more to community life than its political aspects.

It's pretty easy for an engineer to lean on his technical background to find fault with the solutions which laymen work up to solve community problems. But it's not nearly as easy to find the engineer who is willing to work cooperatively in the hunt for better answers.

Most community organizations could benefit by having someone in their ranks who has been trained to think logically and nonemotionally and who has a realistic appreciation of cost factors.

Take one example: Less than 5% of today's high school students take physics, only slightly more study chemistry, mathematics is rapidly becoming a candidate for "the most abused and neglected subject" title. At the same time a "penny wise and pound foolish" salary structure practically begrudges a trained and experienced science teacher a wage that is already so low it would set a day laborer to lettering his "on strike" placard.

In the face of this situation, engineers and scientists have been quite vocal about the lowering of standards

in the schools and its dire consequences. But if standards are low, active participation of engineers on school boards and in Parent-Teacher Associations is just as low. A few communities with a high concentration of engineers and scientists prove exceptions, but technical men generally shun these activities—to the detriment of their communities and themselves.

Here's an Exceptional Opportunity

But if taking an active part in community activities brings you, your work and its worth to the notice of your neighbors for their benefit and yours, so association with a professional group and participation in its work helps you develop yourself and brings you to the attention of your colleagues.

Joining a professional society gives the engineer an exceptional opportunity for development. Here again, he has a chance to widen his circle of friends and acquaintances. He keeps his technical know-how current and, much more important, he gets chances aplenty to hone his skills in dealing and working with others, administrating projects, public speaking and writing.

While playing an active role in a professional society has many advantages, it's not without a bleak side. Time, of course, is again a major problem. In addition, there's discouragement.

Altogether too many meetings show evidence of a distressing lack of imagination and offer little incentive to attend. It should be realized that every time a professional society or one of its chapters organizes a meeting, it's immediately in a frenzied competition.

What's it competing for? Time. The hours it takes to hold the meeting are also hours which could be filled with a hundred and one other things. Vying for attention in those same hours are a host of people who have made winning and holding an audience their profession —and who can do a pretty good job of it.

To attract support, society meetings should be conceived and merchandized with this in mind.

Some professional organizations have met this problem with imagination and have grown healthy with new blood as a result. Their example could profitably be aped by others. You'll be helping yourself by bearing a hand in shaping such a program for your group.

This Isn't Easy

Possibly the most important area in the ECPD program is that labeled self-appraisal. Taking a fresh look at your goals and your progress toward them periodically forms a vital part of any personal development plan.

But coming up with an honest, objective rating of oneself and one's progress can be a pretty rough task. And one that's easy to put off.

To help the engineer, ECPD has worked up a personal appraisal form containing some two dozen questions about personal and professional progress that are worth pondering. Other sources offer similar forms. But a form only guides, it's the thinking that counts.

To keep your thinking objective and your appraisal unbiased, bring in the opinions of others. Talking over your strengths and weaknesses with a friend whose experience you can lean on and whose judgment you trust, can aid you.

Making these appraisals regularly and scheduling the time for them early enough helps to skirt any tendency to put them off. And the more often you take time to check and redirect the path of your development program, the better it will stay on the beam.

Reading Rounds It Out

The last area covered in ECPD's suggestions involves selected reading. This completes and rounds out the program by shoring up its weak points. Since your entire professional development program aims for growth, reading which will broaden and deepen cultural and technical knowledge certainly rates inclusion.

It enriches your own experience with the seasoning of the experiences and thinking of others. It can lift you out of the monotony of daily routine and keep your own thinking alive and properly tuned.

Technical reading, of course, is a must for any engineer. Failure to stay abreast of the latest in his profession inhibits his effectiveness and cuts into his earning power. It makes very good sense for the engineer to dope out some sort of system for keeping up with the literature in his field—as well as with current social and political thought—and do this early in his career.

Twin enemies of this ambition are time and direction. Prudent use of spare minutes (commuting and waiting time, etc.) and courses in rapid reading are allies against the former. Use of such aids as ECPD's "Reading List for Engineers" help combat the latter.

Don't neglect to include a planned program of reading in your development scheme. You'll be gypping yourself out of a lot of pleasure and stunting your professional growth if you omit it.

It's Your Job and Your Gain

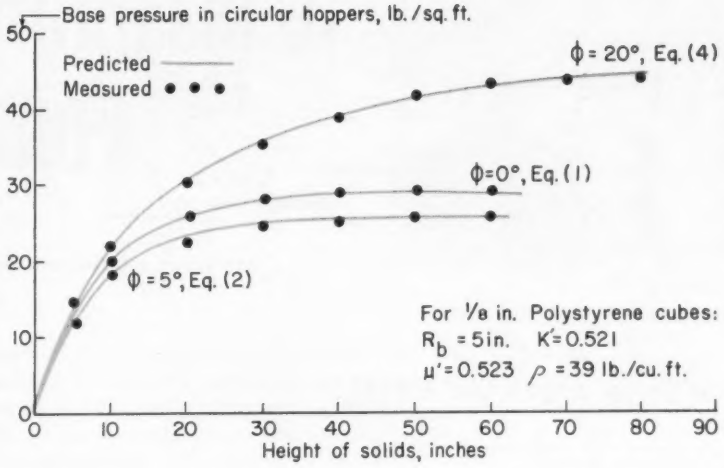
The considerations discussed above can help you get started on your program of professional development and they can guide you in directing it once it's going. But the job of setting up the plan and working it though is yours. And so is the three-fold payoff we mentioned earlier.

While developing your potential is a personal task, both industry and the engineering profession itself can help you by creating a climate which promotes professional development. The famed "Cincinnati Plan," in which companies, society chapters and the university work in concert to give practical help to the engineer bent on developing himself is an example to be imitated more widely.

The biggest force to be overcome in launching your personal development plan is inertia. Once you get the plan started, you'll have relatively little trouble keeping it moving along. It becomes a habit. Now is the time to get it going.

Design a Hopper That Won't Arch

No precise data are available on the base pressure required in a hopper to prevent arching and the resulting restriction of solids flow. But here are some reasonable guides to practical engineering design. Two equations given here will solve most of your design problems.



JULIAN C. SMITH, Cornell University, Ithaca, N. Y.

To find the base pressure in a bin with vertical sides, containing granular solids, you can use the Jannssen equation[2]

$$P_b = \frac{R_b \rho}{2\mu' K'} (1 - e^x) \qquad (1)$$

where $x = -2\mu' K' Z / R_b$

However, when the sides of the container are sloped, as in a hopper, the base pressure may be greater or less than that predicted by this equation, depending on the inclination of the sides.

Data given by Rudd[4] indicate that for a given base area, when the sides slope a little, the base pressure is less than with vertical sides; but when the sides slope considerably, the base pressure is greater than when the sides are vertical.

Recently the Jannssen analysis has been applied to hoppers to explain the variation of pressure with height.[5]

But this analysis fails to explain the observed variation of base pressure with the angle of inclination. Furthermore, direct equations for predicting base pressure in hoppers with sloping sides are not available in the literature.

The analysis that we present here is based on the assumption of a "plane of incipient failure" in a conical hopper. Jenike[1] has calculated where failure would occur in a bin filled with solids. However, since the material at the top of the bin has little effect on the base pressure, we have assumed that the base of the hopper supports a cone of material as shown in Figs. 2 and 3.

When the angle of inclination of the walls is small (of the order of 5°) the supported cone becomes a cylinder with vertical walls.

It's possible to work out force patterns for these shapes.

Force patterns in hoppers with sloping sides are shown in Fig. 2 for small angles of inclination and in Fig. 3 for larger angles. For the first case, if we apply Jannssen's analysis to the cylinder of supported solids and make allowance for the increased frictional support of the sloping walls, we get this equation for the value of base pressure:

$$P_b = \frac{R_b \rho}{C} (1 - e^{Ca}) \qquad (2)$$

where $a = -Z/R_b$; and where

$$C = 2[(1-K')\sin^2\phi + K'][\mu' + \tan\phi] \qquad (3)$$

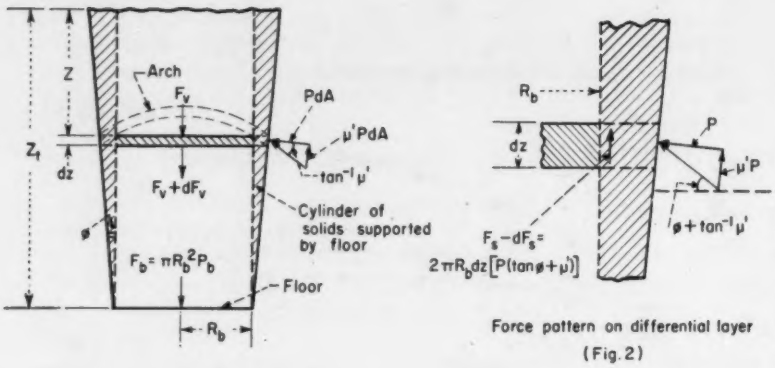
For small values of the angle ϕ,

Nomenclature

B	Constant defined by Eq. (5)
C	Constant defined by Eq. (3)
F_b	Force on hopper flow, lb.
F_s	Supporting force, lb.
F_v	Vertical force, lb.
K'	Ratio of normal to applied pressure in solid mass
M	Constant defined by Eq. (6)
P	Reaction pressure, lb./sq. ft.
P_b	Base pressure, lb./sq. ft.
P_L	Lateral or normal pressure, lb./sq. ft.
P_v	Vertical pressure, lb./sq. ft.
R	Radius of cone of supported solids, ft.
R_b	Radius of base of hopper, ft.
Z	Vertical distance from top of solid mass, ft.
Z'	Vertical distance from hopper floor, ft.
Z_t	Total depth of solids in hopper, ft.
μ'	Coefficient of friction, solids to bin wall
ρ	Bulk density of solids, lb./cu. ft.
ϕ	Angle of hopper wall with vertical
Ψ	Angle of cone of supported solids with the vertical

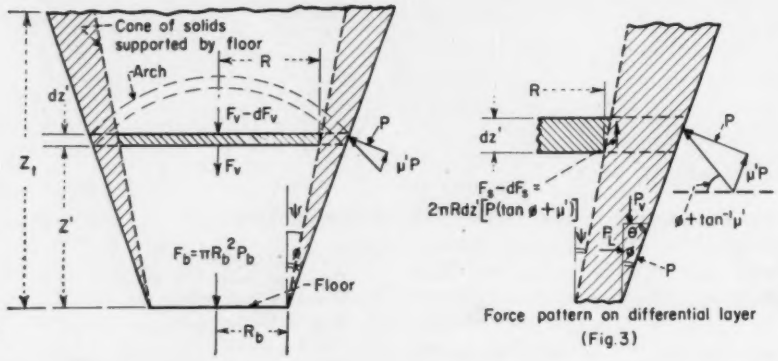
JULIAN C. SMITH *is professor of chemical engineering at Cornell University. Active consultant, Smith is also a frequent contributor to these pages. His latest: "How to Approach Your Separation Problems," part of our June 1955 feature report.*

Use Eq. (2) When ø Is About 5°...



Force pattern on differential layer
(Fig. 2)

For Larger Angles Use Eq. (4)



Force pattern on differential layer
(Fig. 3)

Eq. (2) gives results that agree well with published values[4]. (See Fig. 1.) Probably, Eq. (2) does not hold if ϕ is larger than about 5°.

When ϕ is larger than 5°, the sides of the cone of solids supported by the base begin to slope as shown in Fig. 3. Designating ψ as the angle between the wall of the cone and the vertical, the base pressure can be expressed as:

$$P_b = \left[\frac{M}{3-B}\right]\left[\frac{(R_b+Z\tan\psi)^{(3-B)}-R_b^{(3-B)}}{R_b^{(3-B)}}\right] \quad (4)$$

where $B=[2/\tan\psi][(1-K')\sin^2\phi+K'][\mu'+\tan\phi]$ (5)

and

$$M = \rho/\tan\psi \quad (6)$$

The angle ψ must be found by experiment. From published data[3] for polystyrene cubes with $\phi = 20°$, and Z = 5 ft., we computed ψ to be 13 degrees and 47 minutes. Substituting this value into Eq. (4) gives good agreement of the calculated base pressure with published values (see chart on preceding page).

The straightforward Eqs. (2) and (4) give results that are sufficiently accurate for engineering purposes. When the angle of inclination of the hopper walls is small, Eq. (2) permits direct estimation of the base pressure. When the angle is large, a single measurement to find the value of ψ is sufficient for predicting pressures at varying depths. Use the measured value directly in completing the solution of Eq. (4).

We believe that the equations proposed here are sound mathematically but wish that we had some more experimental data to check them with. Our experimental programs planned for next year will be directed toward that objective.

Application to Design

The discharge opening at the bottom of a hopper—and the static pressure at that point—must be large enough to prevent arching over the opening and to give a satisfactory discharge rate.

When a bin has vertical sides and a flat bottom, the rate of flow of solids through a bottom opening is independent of pressure and varies as the cube of the opening diameter.[2] The base pressure is scarcely affected by the motion of the solids.

However, in the slope-sided hopper this is not true. The lateral pressure is almost the same when the solids are flowing as when they are stopped; but the pressure perpendicular to the hopper walls (and presumably the base pressure also) falls when the discharge is opened, and rises when flow stops. This is the result of incipient arching. In a large hopper filled with free-flowing grain the drop in pressure on opening the discharge may reach 100 lb./sq. ft.

The static pressure at the base of a hopper must be larger than the pressure change when the discharge is opened, or the solids will arch across the opening, the pressure will fall to zero and as a result there will be no flow.

With coarse solids the diameter of the discharge opening should be at least eight to ten times the diameter of the largest particle. Once this restriction is met, a base pressure of 10 to 20 lb./sq. ft. will give fairly rapid flow (see Fig. 1).

With fine-grained cohesive solids, on the other hand, the tendency to arch is much greater than with coarse solids. When K' is small, say 0.1 or 0.2, the discharge opening should be large enough to give a considerably greater static pressure. A minimum value of 50 lb./sq. ft. is probably adequate in most cases.

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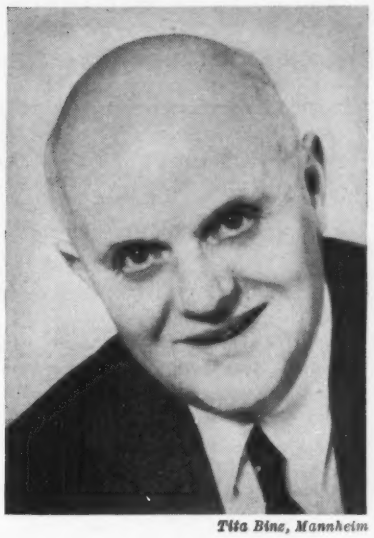
An Editor's Impressions of CHEMICAL ENGINEERING IN EUROPE



Tita Binz, Mannheim

SIDNEY D. KIRKPATRICK

CE's Editorial Director is back from a long business trip to Europe. While over there he sent us a series of interesting letters recounting his contacts with some of the leading chemical industries and chemical engineering personalities. They dealt largely with people, rather than stodgy events or sterile statistics. Here are some random samples of his impressions and observations you too may find of interest.—JRC

CHEMICAL engineering and chemical industry are moving rapidly ahead in Europe today. That progress from the standpoint of our profession, is most encouraging even though it may well portend more serious competition for American products in world markets.

Much of Europe's chemical progress is based on American methods and equipment, cleverly adapted to meet local conditions and national needs. But there has also been a real resurgence in research and education that will greatly lessen that dependence in the future.

During a recent trip of seven weeks to ten European countries, I was most impressed with what I saw and heard in England, Germany and Italy. Switzerland, too, continues as a strong, resourceful chemical contender—particularly for process equipment and in chemical engineering education. France may also be improving her position, but progress was not so immediately apparent to this observer. Nor did I get the same feeling of urgency and determination in my briefer contacts with chemical people in Norway, Sweden and Spain. Yet all of these and many other nations actively participated in the history-making Congress of the European Federation of Chemical Engineering, which I attended in Frankfurt during the ACHEMA XI exposition there.

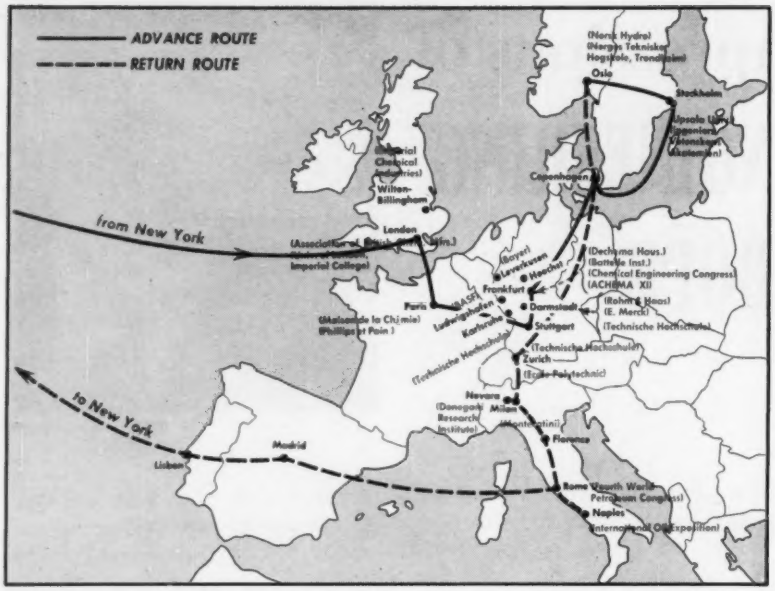
Emphasis on Productivity

Productivity in the British chemical industry has been rising rapidly and consistently ever since the war. Much of this can probably be traced to the work of the Anglo-American Council on Productivity and particularly to the several visiting teams of engineers and industrialists with whom many of our companies shared experiences a few years ago. It is gratifying to see the extent to which the Association of British Chemical Manufacturers has organized and supported this program for promoting freer exchange of technical and statistical information and, especially, the practical values to be gained from work-study techniques.

Series of conferences and informal meetings have been held in all important chemical centers. Most of the top union officials have supported the program since its inception, but it has taken time to win over some of the local units and work councils. ABCM reports that productivity increased 8% per year from 1946 to 1950.* Then it jumped to 14% in 1951. Imperial Chemical Industries, the recognized leader in the works study program has more than doubled its production since 1946 with an increase of only 17% in its personnel. Russell M. Currie, head of ICI's Central Work Study Department, has estimated that in 1953 work study and incentive payment schemes resulted in net savings of nearly $6 million. When last year's figures are finally toted up, they should show even greater savings in 1954.

Another significant factor in Britain's progress has been in the increasing use of American engineering firms. There were no prewar counterparts for such organizations in England, but the AACP teams were quick to recognize the important contribution that independent engineering firms could make to postwar construction and modernization. First used extensively in building Britain's new petroleum refineries and petrochemical plants, a number of these engineering companies quickly extended their work to cover design and construction of a wide variety of chemical processes and facilities. A salutary effect of this trend has been the increasing use of American know-how, equipment and materials. Indirectly this has often encouraged the building

* For a more detailed account of the ABCM's Work Study Conferences, you can communicate with J. Davidson Pratt, General Manager of The Association of British Chemical Manufacturers or with Mrs. Joan Consit, Conference Secretary, Cecil Chambers, 86 Strand, London, W.C.2, England.



of branch plants to supply British needs for these components. Better instrumentation—another AACP recommendation—has resulted from this sort of joint participation by American manufacturers of automatic control and recording equipment.

Among the older generation there is still some smouldering opposition to chemical engineering as a profession. One distinguished corporation chairman, himself a Cambridge chemist, told me that personally he would prefer to make his own chemical engineers. How? Very simply, he said. Merely put a chemist and a mechanical engineer in the same office for a couple of years. They will fight for sure but enough chemistry will rub off on the engineer and enough engineering on the chemist so that they will end up by both being fairly good chemical engineers!

I did not agree, of course, and pointed out that when his own personnel people were combing the country for technical men they could ill afford to waste their efforts in this duplication and dilution of talents. Later on in conferences with Sir Harold Hartley and Dr. Herbert Cremer, both past presidents of the Institution of Chemical Engineers, I became convinced that chemical engineering is already well recognized as a separate branch of engineering. Accredited courses in chemical engineering are being given in almost a dozen universities in Great Britain and the end is not yet in sight.

An incidental observation is the extent to which British consulting engineers are concerned with technical programs for backward or underdeveloped nations. Their "Point IV" programs have no governmental sponsors. But a surprising number of chemical engineering projects are under way in India and in Morocco, Ugandi and other parts of Africa.

Germany's Miracle

Germany's industrial recovery is little short of miraculous. Most of her great chemical plants have been completely rebuilt and are being operated at full capacity to supply the growing export as well as domestic markets. On the surface there seem to be no adverse effects of the decartelization program. In fact the opposite may be true because of the increasing competition and rivalry among the former I.G. units.

The chemical industry of West Germany is exceptionally well organized and through its strong trade association—Verband der Chemischen Industrie—is carrying on an active, aggressive, educational and propaganda program at home and abroad. Its able leaders, W. A. Menne and Hans Stork, are well-known in American chemical centers.

Karl Falk, our former German correspondent, has recently pinpointed much of this progress in *Chemical Engineering* (See "Germany Shifts to New Technology," May 1955, pages 182-5). He has clearly shown how high-cost raw materials have forced much of the industry to change from coal to petroleum hydrocarbons—despite the relative scarcity of gas and crude oil supplies in West Germany.

As Professor Falk and I visited the huge plants at Ludwigshafen, Leverkusen and Hoechst, I was impressed by the bold, open-type engineering construction so strikingly similar to our own petroleum refining and petrochemical facilities. But I was also surprised in a number of instances to see older dyestuff plants, for example, that had been rebuilt exactly as they were before their wartime destruction. Many of the synthetic-ammonia units, on the other hand, had been converted from coal to natural gas through modern chemical engineering processes and equipment. The famed acetylene processing plants for "Reppe Chemie" are still the world's largest and most productive in quantity and variety of products.

Some of the newest and finest buildings in Germany are for industrial research. Only few American chemical companies can boast of comparable facilities for research and pilot plant developments. The well equipped and efficient laboratories headed by Dr. Walter A. Reppe at Badische are among the best I have ever visited. And indicative of interest in economics as well as technology, more than 300 chemists and engineers crowded into the laboratory auditorium at Ludwigshafen to hear Dr. Falk's Fulbright lecture comparing American and German chemical industries.

None of us is foolhardy enough to believe that American chemical engineering has set a pattern for other nations to follow. Certainly we saw very little evidence in Germany of any major change from the traditional chemist-engineer combination that had been responsible for the early development and progress of her chemical industries. The outstanding exception is probably at the Technische

Hochschule in Darmstadt where Professor Karl Schoenemann heads the new Ernst Berl Institute of Chemical Technology. His courses and personal interests closely approximate those of many American chemical engineering educators.

Since the war there has been an important development in certain other educational institutions which we in America can well afford to study. I refer to the increasing number of courses in process engineering (Verfahrens Technik) that have as their objective the specialized training of mechanical engineers in thermodynamics and physical chemistry in order to equip them for more effective careers in the chemical industries. Two of the recognized leaders in the development of this new profession are Drs. Kurt Riess and Horst Miessner of Farbenfabrik Bayer at Leverkusen. Their article on "Verfahrens-Ingenieur und Chemical Engineer," published last fall in *"Chemie-Ingenieur-Technik"* (Vol. 26, Nos. 8/9, pp. 429-37) has already attracted wide interest among chemical engineering educators. It is especially significant that the most recent innovation is the introduction of courses to cover economic and management problems of the chemical industries. This is a break with tradition for in the past German engineers were seldom encouraged to take on top managerial responsibilities, even for production and plant operation.

A Unique Organization

One of the valuable assets of the German chemical industry, which has no exact counterpart in the United States is "Dechema" (Deutsche Gesellschaft fuer Chemisches Apparatewesen). The Dechema-Haus in Frankfurt, with its Institut feur Apparate-und-Stoffkunde is fast becoming the European information center for chemical engineering equipment and materials. Dechema's periodic expositions known as ACHEMA have undoubtedly contributed greatly to the progress of her chemical industries. First organized in 1920 by Max Buchner for the Chemical Plant Section of the Verein Deutscher Chemiker, they have taken on the magnitude and scope of World Fairs for technology and equipment.

Dr. Herbert Bretschneider, who succeeded to the directorship of Dechema and has been largely responsible for its great growth and development, was also a vital force in organizing the European Federation for Chemical Engineering in which 23 engineering and scientific societies from 13 nations joined in sponsoring the recent World Congress. Only the British who in 1936 staged the first International Chemical Engineering Congress in London have so far declined to participate in the new federation. Yet many of their members attended and some took active part in the Frankfurt meetings and the ACHEMA exposition.

Germany's Show of Shows

Trade fairs and industrial expositions seem to play a far more important part in the European economy than in ours. This may be only the result of long established custom and tradition. But I suspect it may also be due in part to less effective means and facilities for communicating technical information. In any event, the ACHEMA exposition has become a great marketing place and clearing house for technological developments of both materials and equipment.

American visitors were immediately impressed by the tremendous size and scope of ACHEMA XI. By any measure it is several times as large as any of our own chemical expositions. Utilizing the permanent facilities of the Frankfurter Fairgrounds, a dozen spacious buildings were filled with almost a thousand exhibits. Some of the so-called "stands" were the equivalent to 8 or 10 of our exposition booths. Most of the exhibition halls had upwards of 50 feet of headroom, with ample cranes and service facilities, so that tall columns and heavy equipment could be shown. In addition there were quite a number of outdoor exhibits where the very largest equipment and operating units were on display. With gas, water, steam and sewer connections available, a number of units were in actual or simulated operation.

Nearly all of the larger booths provided semi-private sitting rooms or dining alcoves where you could drop in for coffee, tea or cognac. Often an attractive young lady would graciously prepare your beverage while a team of technical representatives would ply their trade. Perhaps some enterprising exhibitor in Philadelphia next December will introduce this interesting and not unwelcome innovation.

A word now about showmanship: In American vernacular I would say that the exhibits were "gold plated." Each exhibitor seemed to take greatest pride in the workmanship and appearance of his equipment. There were ceramic lined tanks and chimneys that looked like they had been done by a Michael Angelo. In the Materials of Construction Hall I saw rolls of copper and bronze 50 ft. long, and burnished to look like solid gold. Even Badische's spiral-wound pressure vessels had highly polished cross sections of contrasting layers that reflected real craftsmanship. All of which is further evidence of the extent and expense to which the German exhibitors will go in order to attract interest in their wares.

Zurich's Famous ETH

Any American chemical engineer who has the chance should not fail to visit the new chemical engineering laboratories of the famous Ecole Polytechnic of Zurich. After rummaging around the dingy halls of many other European universities, it was refreshing to see these new, clean, modern and well-equipped laboratory facilities and pilot plants. My guide was Dr. Pio Guyer, the son of Prof. Dr. A. Guyer, the brilliant director who had had a leading role in the Chemical Engineering Congress in Frankfurt.

The five-story building—or buildings—occupy a square block in the center of the city. The first section housing the offices and a few older laboratories was built in 1888 when the great Dr. Lunge headed the ETH (Ecole Technische Hochschule). The big unit-operations laboratories and pilot plants were completed within the past two years. There are about 800 students in ETH with at least 50 post graduates working for their doctorates. Each graduate student has a desk and office with an adjoining laboratory for his bench work. Each also has at his disposal a section of the unit-operations and pilot-plant areas.

The unit operation facilities provide

G. G. Lanham, ICI construction manager at Wilton, points plans for future growth.

maximum flexibility. Services for gas, water, steam, air pressure and vacuum are concealed in wall panels. They are also cross-linked under the floor at 20 ft. intervals so that connections can be made by lifting a plate or a grid. The student then sets up his own aluminum scaffolding that clamps into floor and ceiling to provide a firm base for attaching equipment, control instruments and accessories. I saw several intricate set-ups that involved continuously operating catalytic processes, complete with tiny centrifugal pumps, automatic valves, rotameters, etc.—something I never thought possible on such a miniature scale. But Dr. Guyer pointed out that by spending more time and money on these perfectly scaled lab units, one can often avoid much more expensive pilot planting.

But there had been no stinting of expense in equipping the pilot plants, especially the annex designed for high pressure work. Specially barricaded sections house the control equipment and compressors. The latter are capable of producing pressures as high as 4,000 atmospheres. The reactors are heavily barricaded with concrete walls on three sides, while the remaining wall is lightly constructed of wood for explosion relief. Hydrogen for hydrogenation work is generated in electrolytic cells at a remote location and piped to pressure spheres outside of the compressor rooms. This is a man-sized operation and the whole ETH physical set-up impressed me most favorably.

Reunion in Italy

Back in 1919 when I was a shavetailed lieutenant running errands for Professor F. W. Taussig and Bernard Baruch at the Peace Conference in Paris, I had the privilege of meeting a great leader of the Italian chemical industry, Dr. Guido Donegani. He had as his assistant a young ordnance officer, Giacoma Fauser, whose name is now known all over the world for his many famous chemical engineering processes. I first met him in the 1930's when his ammonia and electrolytic hydrogen processes were being installed at Trail, B. C. Since then we often corresponded and Dr. Ing. Fauser had frequently written articles for the old "*Chem & Met.*" So I had looked forward to a visit to Northern Italy and especially the opportunity to renew acquaintances with an old and respected friend.

When I arrived in Milan, there was a message from Dr. Fauser saying that a young engineer from the Nitrogen Department of Montecatini would meet me in a company car and drive me to the new Donegani Research Institute and the synthetic fertilizer works at Novara. It is a trip of about 30 miles, mostly by express highway with no speed limit except that of the car!

Fortunately, at least in a way, was the fact that my visit on June 2 coincided with an Italian national holiday (when they celebrate the founding of the new Republic). This meant that the huge new marble palace which houses the Donegani Institute was empty except for the good Dr. Fauser. As he rushed out to meet me, I saw a ruddy, energetic fellow in his early 60's, closely resembling a younger edition of Kodak's C. E. K. Mees. He tried his English, German and French on me—sometimes all three at once—but we ended up mostly with sign language. Nevertheless the welcome was most friendly and the visit one I shall long remember.

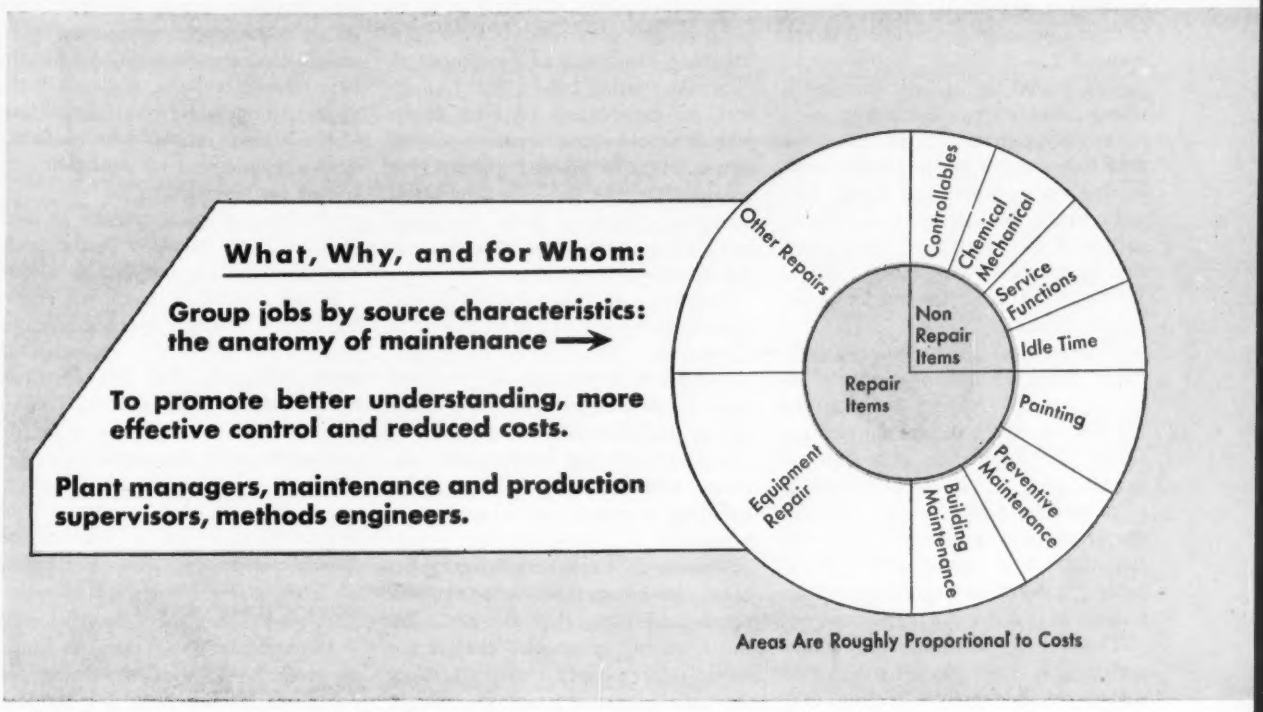
After I had signed the Golden Book and inspected the spacious laboratories, meeting rooms, libraries and semi works in this new and modern institute, we got into the car and started our visit to the adjoining plant. Considering its age—30 years—it is surprisingly up-to-date in appearance and layout. The attractive brick buildings are kept clean inside and out. Exposed equipment was freshly painted with aluminum and contrasting copper coatings.

Dr. Fauser's pride and joy right now is the new acetylene-from-natural-gas plant which was just about ready to go into operation. The partial oxidation process is one that had been developed in the laboratories and pilot plants at Novara.

The synthetic-ammonia plant, which was originally built for hydrogen-from-coal, is now almost completely dependent upon natural gas. The Fauser converters, I was told, were the very largest in the world from the standpoint of capacity. Yet they look comparatively small. The answer according to Dr. Fauser is in the efficiency of his catalyst and the velocity of the synthesis gas through the cycle.

Next we inspected the urea plant where another *Chem & Met* author, Ing. Tito Borelli, was in charge. This, I take it, was the demonstration unit from which some 8 or 10 plants have since been built in various parts of the world. Our discussion then turned to the extent to which other Fauser processes and plants have been built abroad. So when we returned to his office for a glass of wine, I was shown an impressive compilation—in all some 105 installations with total capacity equivalent to more than 2,000,000 tons of nitrogen per year. These included in addition to synthetic ammonia and nitric acid, ammonium and calcium nitrates, more than a dozen electrolytic hydrogen and natural gas reforming plants, as well as many methanol and urea units.

With the tremendous impetus now being given to a domestic petroleum and natural gas industry in Italy, Montecatini is fortunate in having already found its place in the chemical processing of hydrocarbons. The small mining venture that Guido Donegani started in 1888 with less than 200 employees, today operates 157 different chemical and metallurgical plants and has 60,000 on its payroll. Who is to say how much of this growth can be attributed to its scientific and technical organizations—to chemical engineering, by whatever name we choose to call it?



Your Key to Maintenance Savings

R. J. STRATMEYER, Monsanto Chemical Co.

MAINTENANCE is a complex, expensive necessity. Because of this, there has been a continuing search for the key to its cost reduction and control.

There are many ways to attack the maintenance problem. Costs can often be reduced by organizational changes, training programs, improved facilities, and the like.

None of these is basic, however, for the problems of maintenance spring from the individual jobs of which it is composed. Grouping of these jobs by source characteristics to form the "anatomy of maintenance" serves as a key to understanding, which in turn leads to control and cost reduction.

In the following, the importance of each group is indicated. Wherever possible the percentage is based on national survey information, in other cases it is the most reliable compilation of data available. The anatomy itself has been checked against a variety of plants and found to be consistent, although the importance of the groups varied over a wide range.

First step in defining the anatomy of maintenance is to divide it into its two major divisions: repair and non-repair items. Breakdown between the two is about 75% repair and 25% non-repair.

Non-repair items are well worth a long, hard look. One reason they deserve attention is that they fall into relatively few, clearly defined categories that can be more easily controlled than the highly complex mechanical repair segment—and it is an axiom to spend time and money first where the return is greatest.

Non-Repair Items

Non-repair items fall into four general categories: (1) controllables, (2) chemical-mechanical work, (3) service functions and (4) idle time. The 25% previously mentioned applies only to the first two groups for many plants do not include service functions with maintenance and idle time varies so drastically that a percentage would be misleading.

CONTROLLABLES

Controllables are defined as jobs that are subject to direct control. They fall into two categories, revisions and minor installations.

It is a mark of most process departments that revisions are constantly suggested. These may be jobs of the tremendous trifle type like altering a machinery guard, or rerouting a process line for better drainage, or possibly relocating a valve to simplify operations. Or it may be a major revision such as relocating a key operating unit to fit in material handling

equipment, or a drastic piping revision to take advantage of a research development.

The second controllable category is minor installations. According to a recent survey[1] practically all companies have minor repair systems where work costing up to a specified figure does not require an estimate or higher authorization. For most companies, the figure (be it $50, $100, $250 or $500) is the same for repairs as for installations.

Therefore, as a regular procedure, most companies group minor installations with their maintenance charges. A few typical examples are these: the installation of a light at a gage glass, or the construction of a single-step platform to make an operation more convenient, or the installation of a plastic safety shield around a flow meter, or the steam tracing of a valve for winterizing.

These two, revisions and minor installations, have characteristics that make it possible to group them as one. Their most important attribute is that none of the jobs is essential to operations, and it is this property that makes them controllable. Many of the jobs are worthwhile and result in improvements in safety, or operating efficiency, or morale, or reduced downtime. But they can, and should, be held in check by a controlling budget.

First line supervisors, by this device, maintain a degree of freedom—freedom to pick and choose and plan so as many jobs as possible can be done for the alloted sum. A budget so applied is the key to quick, substantial savings that may be as high as 3-5% of entire maintenance bill.

This group of charges has another important characteristic: if neglected the jobs it represents do not feed on inattention as do many repair jobs to become bigger, more expensive tasks. Hence it affords a means of absorbing excess manpower (by raising budget limits) or affording some reservoir (by lowering limits).

CHEMICAL-MECHANICAL WORK

Chemical-mechanical work is chemical operator work performed by the maintenance crews because of union restrictions or custom, or often because a mechanic is needed to do the job.

A few examples that will serve to point up the definition are these: dismantling of a piece of equipment to clean the coating from a heat transfer coil, or replacement of filter cloths and filter elements, or removal and reinstallation of blocked pipelines, or repairs that are the direct result of operating errors, or even temporary installations that serve some operating function.

Amount of chemical-mechanical work varies widely from department to department. In an outdoor department where a material is processed close to its freezing point, or where tars or other compounds plate or settle out, this work will be high as compared with an indoor department handling a docile, untemperamental product.

This is an important category because the charges fall into a never-never land of neglected costs. For the operating group the charges are buried in the maintenance costs, while for the mechanical group the charges are based on requests that they are in no position to analyze.

One procedure that will clarify the situation and bring the costs under control is this: segregate the costs and publicize them so the problem is known. Then define responsibilities so the operating group is charged with minimizing or eliminating the incidence of the jobs, while the mechanical department is accountable solely for jobs methods and efficiency.

An example of a typical improvement that resulted from this approach is the following series of events:

In one large department monthly charges to the chemical-mechanical work account averaged $2,200. In an attempt to reduce this a study was made and a few jobs singled out for special attention. One of these jobs consisted of cleaning the heat transfer surface of a jacketed vessel every two months. It was an insignificant task in that it occurred only six times a year, and never more than three men were involved at any one time.

Still, when the charges were collected each cleanout averaged slightly in excess of $400 or about $2,500 a year. When the charges were first collected the amount seemed inordinately high, but a detailed check indicated the following operations were required: remove pipelines, blank off all nozzles, remove manway cover, install temporary lighting, clean the heat transfer surfaces, and restore the system to operating condition. Many of the blanked nozzles were insulated, so the replacement of insulation continued for several days.

The operating supervisors at once directed their attention to the problem. Shortly thereafter they developed a chemical wash to be applied during shutdowns without opening the system. This not only eliminated the mechanical job, but also increased the efficiency of the unit by keeping it cleaner. Similar jobs in other departments were uncovered where a chemical wash could not be developed. In these cases, mechancial job improvements (such as low-cost removable insulation) were developed.

SERVICE FUNCTIONS

In some plants such items as janitor or porter work, window-washing and other similar functions are included in maintenance. Such work is not part of mechanical repairs and it should be segregated and studied as a separate problem. Since the work is often of a repetitive nature some of the techniques of methods improvement can well be applied, and the work is definitely subject to budgetary control.

IDLE TIME

By idle time is meant paid maintenance manhours in excess of the hours required to complete the work at normal efficiency.

The problem varies widely from plant to plant, or in a given plant from month to month. It is most serious in plants that maintain at a high level. Here, if there is a sudden temporary drop in the normal load, there may be an insufficient backlog of small repair jobs to absorb the slack.

It can also be a serious problem in a sellers' market. Under this situation, the optimum size of a maintenance force becomes larger. This is so that every shutdown job can be promptly manned to reduce production losses to a minimum.

Many other situations can give reluctant birth to idle time. Among these are such things as a shutdown of a large department, or an imperfect

Summary of Maintenance Costs for a Typical Department

Description	Control	Year's Actual Expenditure	Non-Reducibles
Controllables	Budget	$5,100	$5,100
Chemical-mechanical	Proper definition of responsibilities & detailed job studies	6,300	3,780
Painting	Budget based on engineering forecasts	2,800	2,520
Preventive maintenance	Budget based on engineering forecasts	5,600	4,480
Equipment	Comparison of yearly cost of each item with standard & study of high cost items	16,200	13,770
Process piping	Systematic job study	10,100	2,525
Service piping	Systematic job study	800	400
Ductwork	Systematic job study	400	400
Steel structures	Systematic job study	700	700
Foundations and roadways	Systematic job study	200	200
Power wiring	Systematic job study	1,500	900
Light wiring	Systematic job study	400	400
Instruments	Systematic job study	3,400	680
Insulation	Systematic job study	1,900	285
Miscellaneous	Systematic job study	6,600	660
Totals		$62,000	$36,800

Building maintenance is not listed for it is studied on a plant-wide basis.

Miscellaneous in an actual department would be broken down into several sub-categories.

Supporting sheets detailing the nature of "non-reducible costs" jobs should be prepared to support the totals listed.

Optimum level of costs will fall between $62,000 and $36,800. There is approximately $25,000 of costs yet to be analyzed.

scheduling or forecasting procedure, or even the onset of a cost reduction program (of all things!) when supervisors postpone many jobs to reduce their costs.

Accurate measurement of idle time is difficult for workers quite naturally adapt their pace to the work load.

Consequences of such a situation are many, for the cost of having idle men on the payroll is compounded by longer downtime on operating equipment. Invariably worker morale and job attitude are damaged.

A reasonable goal for management is to be able to accurately measure the extent of idle time so informed decisions can be made. One device to accomplish that goal is this:

In every organization there are always jobs of marginal value that either are not proposed to management because they are marginal or, if proposed, are rejected. There are also many jobs that would make operations easier, or improve appearance, or reduce the future cost of maintenance—but that cannot be justified on a return-on-investment basis.*

If jobs of this type are carefully tabulated and held in reserve, they can be used to absorb any excess manpower. And if the jobs are isolated in the accounting records, the amount of the excess can be accurately measured. Management, by this technique, will obtain not only accurate information but also a definite return on its money. A true cost picture will be obtained on all jobs, downtime losses will be reduced, and morale maintained.

The worker also benefits, for the apprehension and fear of layoffs that is the constant shadow if idle time is eliminated. Management, getting a fair return for its money, can be deliberate in making any change in the work force. More stable employment will result.

GENERAL COMMENTS

These four—controllables, chemical-mechancial work, service functions, and idle time—are the chapters of the story of the non-repair segment of maintenance. Their segregation from the maintenance account automatically defines the remainder as mechanical repairs.

When a maintenance force is held primarily responsible for repair charges only, a group over which they have some control, there is increased interest and higher morale.

None of the four groups has any relationship to an index. So in the search for a measuring stick look only to mechanical repairs and, as will be developed later, to only a segment of those.

Repair Items

Bulk of maintenance, approximately 75% of the total, is expended in true repairs. These fall into two general classifications: (1) those that can be controlled directly by long range engineering forecasts and budgets, and (2) those that cannot be so controlled but can be traced to energy or corrosion.

CONTROLLABLES

There are three groups important in essentially all plants that can be controlled by engineering forecasts and budgets. These groups are: (1) painting, (2) preventive maintenance functions, and (3) building maintenance.

Painting for a group of Monsanto

* Some examples are these: In a batch process the cycle time of the production limiting system could be decreased by extensive repiping with larger size pipes, but the profits from the increased production were not quite sufficient to justify the expenditure. In another department a large amount of equipment, heavy ducts, etc. were located on the top level of an open steel structure. Replacement of equipment necessarily involved the use of gin poles or other rigging devices, but the frequency of use could not justify the installation of permanent overhead beams. In still another department the installation of an additional floor drain would simplify washdowns and improve housekeeping, but no definite savings could be claimed.

plants averaged approximately 10% of the maintenance budget. When the usual variables found in a painting system (surface preparation, film thickness, proper generic system, routine inspection and spot repairs) are held constant, the life of a system in a given atmosphere becomes a function of time—and consequently is subject to long range forecasts and budget control. Highlight painting and some repairs caused by spills or other exceptional events cannot be forecast, but if properly controlled these are a minor part of painting costs.

The work of Kenneth Tator in the painting area of maintenance provides a dramatic example of what can be done to reduce costs when a problem is isolated and defined.[2]

Preventive maintenance, according to a survey[3] of 52 chemical plants, accounted for 11% of total maintenance manhours—and 64% of those who worked on preventive maintenance spent full time on those jobs.

Heart of the problem of preventive maintenance is whether the program is costing more than it saves—a question to which there is no simple answer. Assuming that for a given plant this question has been answered and a stable program has been set up, the work then becomes a repetitive, planned function that is essentially a constant for a given level of plant activity and consequently can be forecast and budgeted.

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Building maintenance accounts for about 5-10% of maintenance charges and falls into two classifications: jobs that can be forecast and budgeted, and those that cannot. Examples of jobs that cannot be foreseen are such surprises as the burst water main, the sinking roadway, the cracking building, or the leaking roof.

Important? Yes, but of minor importance dollarwise to its companion group of jobs that include such major items as tuckpointing, waterproofing, roof replacements, deteriorated sash replacement, building cleaning, and even replacement of light bulbs. With a few minor exceptions all of these are subject to long range engineering forecasts and budgets. Once these jobs are brought under control the effect of new waterproofing techniques on the life of a tuckpointing job, or the use of new roofing materials, or the use of sealed plastic windows and planned ventilation, or scheduled light bulb replacements can be evaluated.

ENERGY-CORROSION REPAIRS

Energy-corrosion repairs account for about 50% of total maintenance charges. This 50% is the real problem of maintenance for it embraces the steam leaks, the corroded equipment, the squeaking bearings, the wornout switches—or in general terms the pressure, corrosion, relative motion, electrical energy type of repairs.

There is such a wealth of weapons available in equipment designed for maintenance; new corrosion, wear, and heat resistant materials; and new repair techniques; that to define a problem is often to solve it.

EQUIPMENT REPAIRS

By far the largest segment of energy-corrosion repairs are those chargeable to equipment. This group is so important that for all of industry about 30% of plants keep repair records on individual items of equipment—but this percentage is considerably lower in the chemical process industries.

The principles on which this group can be analyzed to locate and price a problem have been set forth by J. D. Leonard.[4] To paraphrase his conclusions, maintenance costs for similar items of equipment will be essentially the same provided four prerequisites are met:

1. Equipment properly selected.
2. Equipment made of proper materials to resist corrosion.
3. Adequate design and erection.
4. Proper and adequate maintenance.

Therefore, if costs are gathered by individual items of equipment for a sufficiently long period, and each item is compared either to a standard or to all similar items, the high cost equipment items can be determined. Once the faulty items are spotted, they can be studied and appropriate measures taken to reduce costs.

OTHER REPAIRS

After all of the clear cut groupings of charges have been segregated, there is still a hard core of repairs that remains. It is so important dollarwise it cannot be ignored, for it totals between 20 and 30% of maintenance costs.

This group presents the most difficult problem of maintenance for it includes a great number of dissimilar jobs. It cannot be simply described, and because of its complexity a systematic approach is essential.

The approach should have two goals: (1) determine and record those charges that are normal and that cannot be economically reduced and (2) seek out and correct conditions that result in abnormally high maintenance.

One workable approach consists of these steps:

1. Divide the group into categories selected to reduce unclassified jobs to a minimum and prevent any single category from becoming too large.
2. Analyze each category and extract the more important jobs.
3. Study these jobs and gather costs.
4. If no improvement can be made, record the job and its average cost as part of normal maintenance. If improvement is possible, evaluate them.
5. If an economical solution has been found, apply it.
6. Check the solution after it has been in use.

Group System

Plantwide Groups

Group Numbers	Description
1	Controllables
2	Chemical-mechanical
3	Painting
4	Preventive maintenance
5	Process piping
6	Service piping
7	Duct work
8	Steel structures
9	Foundations & roadways
10	Power wiring
11	Light wiring
12	Instruments
13	Insulation
To 50	Etc.

Groups Assigned To Each Department For Special Job Studies (Example—Dept. 144)

51	Acidproof brick floors
52	#1-5 conveyor belts
53	Process valve repacking
To 99	Etc.

Group numbers from 100 to 1000 are treated as single job numbers to collect equipment repair costs by items. These are field assigned. When a department reaches 1,000 the series reverts to 100, etc.

Group System Job Ticket

Date: 11-14-54	Equipment No.	Dept.	Group
	None	144	51

Repair acid proof brick floor between columns 7 & 8

Authorized By: John Doe

Individual Job Number Ticket

Date: 12-1-55	Equipment No.	Group	Dept.	Job Number
	None	5	144	10762

Replace gaskets in still-condenser line

Authorized By: John Doe

How to Control Minor Dissimilar Jobs (20–30% of Maintenance Costs)

To outline the mechanics of a procedure to control costs in the "other repairs" category, two minor repair systems will be described and illustrated. Since a problem job is usually unique to a single department, the analysis is best conducted by departments. Major repairs are not included, for larger jobs can easily be identified in the accounting records and grouped with similar tasks.

The function of accounting in a minor repair system is one of collection, grouping, and presentation. Its records can be no better than the data gathered from the field, so the responsibility for proper identification of charges must be borne by the supervisors in direct control of the workmen.

GROUP SYSTEM

This system is so called because charges are collected by groups that correspond to the more important classes of jobs. Mechanics of the system are simple in that each job requires a job authorization ticket listing only the department, the group number and a brief job description.

At the end of an accounting period, the maintenance supervisor receives for each department a summary of the charges by groups and the job authorization tickets. From this information, he can analyze the tickets and select specific jobs for detailed study. Each selected job is assigned a special department group number so the cost of that job can be determined. During the cost collection period the job can be studied and defined so when the charges are available the economic feasibility of all possible solutions can be evaluated.

A typical example of a job under the group system is this:

A maintenance supervisor in analyzing the tickets for a department found that for a six month period 12 tickets in the miscellaneous groups were for repairs to acid proof brick floors. So a special group was assigned to study this job, and every repair of this type was carefully studied for the next three months.

At the end of this time, the number of tickets remained at the two per month average and the costs were averaging $100 per month or $1,200 a year. Cause of the repairs was found to be a combination of improper cement and sub-floor preparation. A procedure designed to correct these two defects was drawn up, evaluated, and adopted. It was estimated that by spending $2,000 the first year and smaller amounts the following two years, the defects could be corrected and repairs reduced to a proper level. It is usually not necessary to continue a special group after an apparently satisfactory solution has been reached, for a faulty solution will soon reveal itself. Therefore the acid-proof brick group was closed, and that group number assigned to another repair problem.

This system is adaptable to the collection of repair charges by individual items of equipment by setting aside another group of numbers on which the cost is determined for each ticket. In this case the job numbers are field assigned and a copy of the ticket listing the job number and equipment number is forwarded to

the accounting department when the job is completed.

INDIVIDUAL JOB NUMBER SYSTEM

This system is so named because a specific job number is assigned to every task regardless of size. Because of the great number of tickets involved, the numbers are field-assigned either by the use of prenumbered tickets or form blocks of numbers allocated to each supervisor. For accounting to perform its function of collection, a copy of each ticket containing either a group number or an equipment number must be forwarded to the accounting department.

A typical ticket is illustrated. Under this job number system the total monthly charges by groups are available as well as the cost of each job comprising the group. In addition, equipment charges can be accumulated by items.

COMPARISON OF SYSTEMS

For a systematic job study approach, the group system is entirely adequate and it will lead to a thorough study of all the elements of a maintenance account. However, the individual job number system will also do this and has certain additional advantages. Obtaining costs on every job makes for a more taut organization, for any job that runs unusually high can be investigated. Another advantage is that as soon as a problem is spotted, the costs attributable to that job can be obtained at once by checking the completed tickets file.

To further clarify the procedures and illustrate the differences in the operation of the two, an example of a problem handled under each system follows:

Under the group system, a routine check of the process piping tickets indicated an unusually high number of valve repacking jobs. A further investigation revealed that the problem valves were all located in two areas, so a special group number was assigned to them. While the charges were being collected, it was determined that these valves were handling alternately hot and cold solutions and the synthetic packing used was not suitable for this type of operation. A variety of other packings were tried without success, and two different types of packless valves were tried one of which gave satisfactory service.

Because of the nature of the problem, three month's charges were considered adequate. They indicated that the repacking was costing an average of $25 per valve per year. The installed valves fortunately were stock items and could be salvaged, so the net cost of replacing one valve was estimated at $35. This represented an attractive expenditure so the replacements were made.

A similar job, also involving process piping, was handled under the individual job number system in the following manner:

Process piping charges for a department making an intermediate were unusually high, so a detailed check was made of the job tickets charged to that group. In this case, the tickets for a six month period were sorted by job type and the total charge for each type determined. One of the larger groups was for gasket replacements—it totaled $600 for the period. Under this system the analysis was more thorough and the dollar cost of the job was known immediately.

An investigation revealed the department contained an unusual amount of process piping, most of which was insulated. Since all work is charged to the basic job, insulation removals and replacements were charged to the gasket replacement tickets thus magnifying the problem.

It was also discovered that the asbestos-rubber composition gaskets used were attacked by the product, and in the process of deterioration swelled in size. This swelling made it difficult to remove the gaskets and further increased the cost.

The solution was found to be metal gasket with a special filler that was completely resistant to the product. The price difference between the composition gaskets and the metal gaskets was very substantial but it was insignificant compared to the cost of a gasket replacement, so every gasket replacement is now done with a metal gasket. Savings, of course, were not immediate but in a period of years this class of repairs should virtually vanish.

All problems do not end in such a happy fashion. In many cases a solution could not be economically justified and in others the solution did not work out as expected. But even in these cases additional insight into the problem was gained.

GENERAL COMMENTS

Now that all parts of the anatomy of maintenance have been discussed, it will be interesting to note certain critical points and re-examine certain basic ideas.

Whenever a different approach to a problem is suggested, the first question is usually how much will it reduce costs? If a plant is not using a systematic study of repair charges, the answer is that for a department or a plant there is an optimum level of maintenance. This is by no means the lowest possible maintenance cost level, but it is the point at which improvements begin to cost more than they are worth. The procedures outlined are designed to reach this level by the use of engineering budgets where possible, and by requiring justification for maintenance-reducing expenditures.

Of equal importance is the determination of those maintenance costs that are already at the optimum level. Therefore, the maximum savings that can be expected is the difference between the present cost of maintenance and the optimum level. Unfortunately, there is no way of determining this until that level has been arrived at.

Control has been mentioned many times, and it means a different thing to the different levels of management. The approach described herein is designed to tell the lower levels of supervision where their dollars are going. If control of costs are good at the department level, they inevitably will be good at the plant manager's level. Moreover, with proper control at the lower levels, the minor repair job limit can be raised. Savings in time and paperwork—as well as the many benefits of better delegation of authority—will result.

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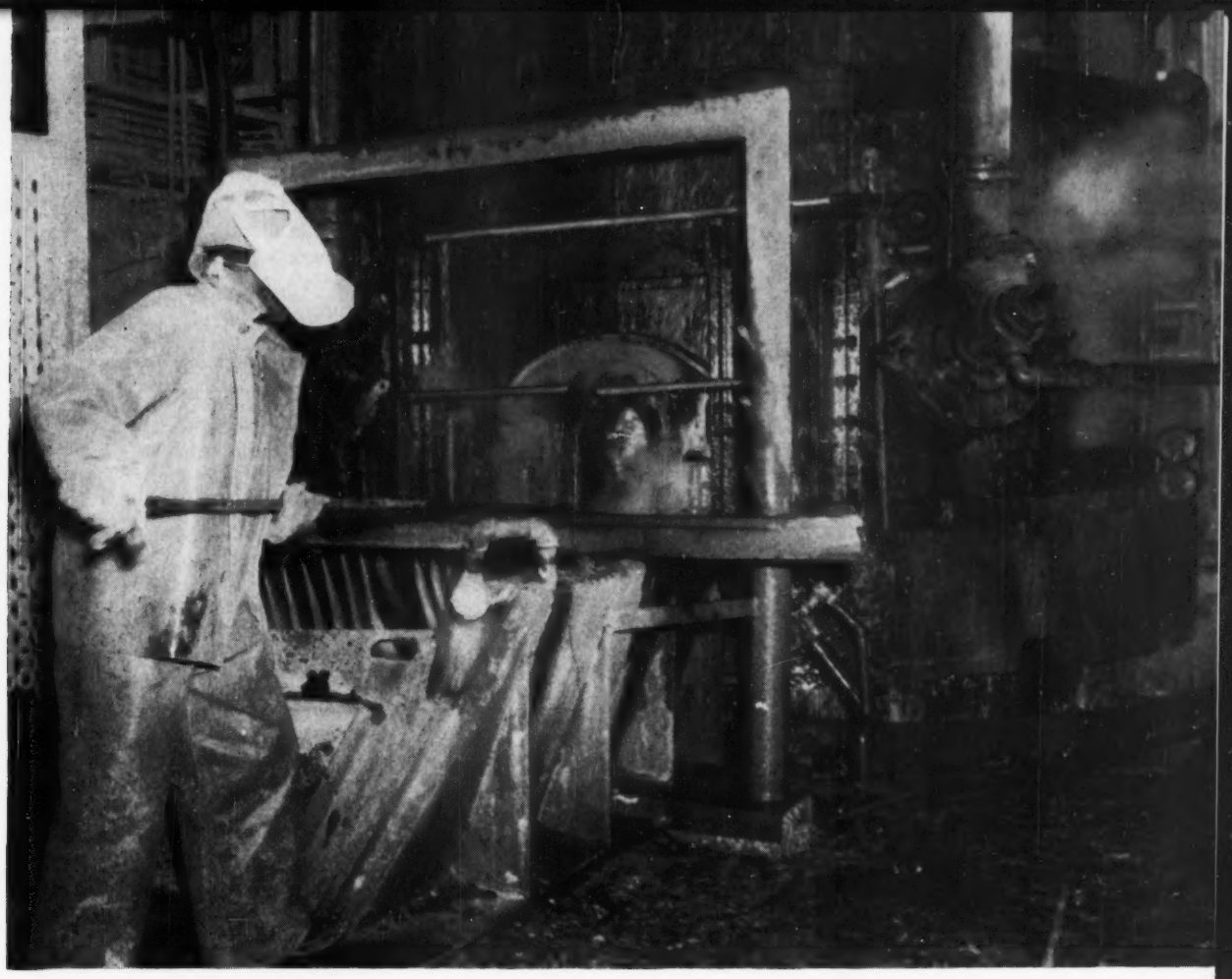


HANDLING A CORROSIVE, high-temperature fusion reaction for tricalcium phosphate, TVA solved the problem of . . .

How to Build a Graphite Furnace

Some novel techniques were developed here, in the construction and operation of a furnace hearth made out of graphite blocks.

L. H. ALMOND and W. L. ALBRECHT, Tennessee Valley Authority

Extremely high temperatures, and severe corrosion situations are some of the conditions encountered in our work at TVA in the production of fused tricalcium phosphate.*

One of the most difficult design problems centered around the development of a furnace hearth with a satisfactory life span.

A hearth built of graphite blocks proved to be an adequate answer. Only a small amount of wear showed up, after 17 months of use.

We are going to describe, in some detail, the graphite hearth, as finally developed.

But before doing that, consider the conditions in the hearth. Making fused tricalcium phosphate involves melting and defluorinating a mixture of phosphate rock and silica in the presence of water vapor.

Temperature of the melt tapped from the furnace ranges from 2,550 to 2,700 F. At times flames from the burners impinge directly on the hearth wall. Practically all refractories that withstand such temperatures react with molten phosphate rock. Although the fuel burns with a slight deficiency of air, there are times when oxygen is present. Cooled metallic surfaces, such as cooling tubes and the hearth shell, are corroded by fluorine and sulfur compounds in the furnace gases.

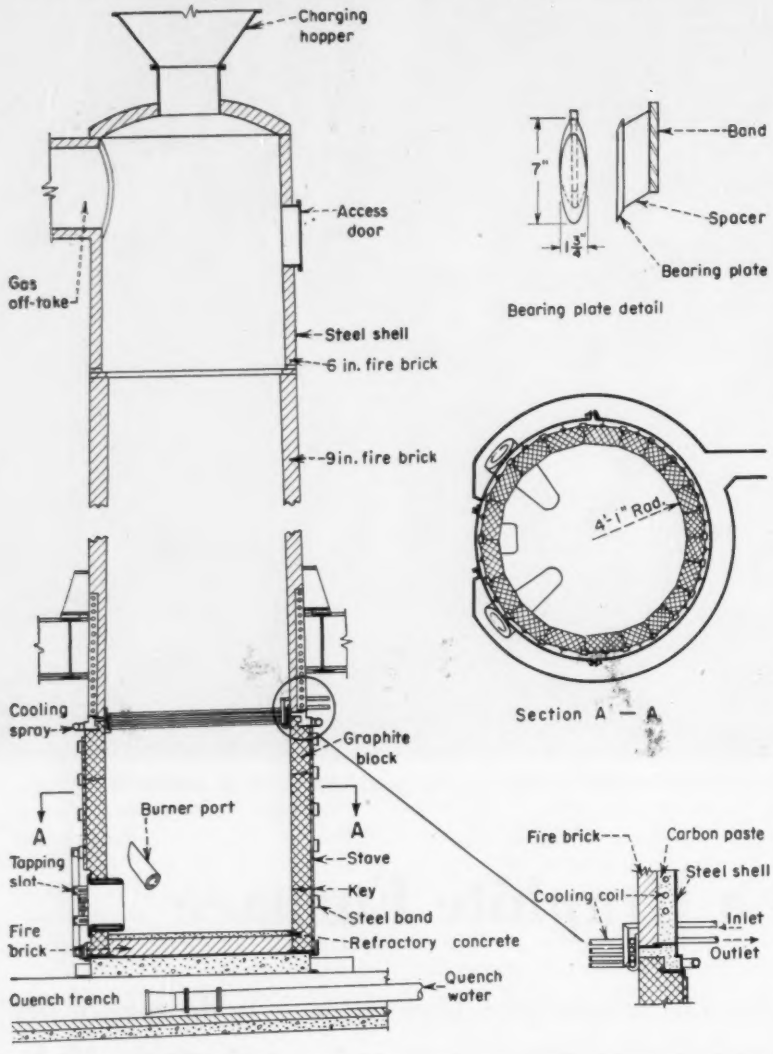
Five different types of hearth construction were tried, before graphite. None of them lasted more than a year without major repairs, and the useful life of most was only eight months.

Intriguing Possibilities

Why use graphite? It is not attacked by fluorine and sulfur com-

* The nature of these difficulties, and the steps taken to overcome them, are set forth in TVA's Chemical Engineering Report No. 7.[2]

A Furnace Hearth Made Out of Graphite



pounds. Its thermal conductivity, about 20 times that of ordinary carbon and about one-third that of copper, makes it possible to keep the interior surface of a thick block of graphite below the ignition temperature of about 800 F. by flowing a film of water over the outer block surface.

Graphite will react with molten phosphate rock, but this was not regarded as a serious difficulty because the graphite could be kept cool enough to provide a layer of frozen phosphate which acts as protection against the molten material.

However, the use of graphite in the hearth section posed certain problems. Because of its low mechanical strength, a graphite hearth would have to be reinforced to enable it to withstand the mechanical shocks of stock slides and the severe vibration that occurred when molten phosphate partially covered the burner ports. The reinforcement could not be in the form of a steel shell, because this would prevent adequate cooling of the interior of the graphite wall and would interfere with expansion and contraction of the graphite.

Phosphorus combustion chambers of TVA's phosphoric acid plants at Wilson Dam, Ala., had been built of graphite blocks[1,7,9]. Experience gained through design of these chambers was helpful in designing the graphite hearth.

Constructing the Furnace

The fusion furnace is shown in the drawing. Graphite blocks that form the hearth are 11½ in. thick and were assembled to form a 20-sided, approximately cylindrical section 8 ft. 2 in. inside diameter and 10 ft. 4 in. high. The blocks were machined by the manufacturer.

It would have been desirable for each block to be the full height of the hearth section, but graphite blocks of such length were not obtainable and it was necessary to provide horizontal joints. Ten of the sides of the hearth wall are made of two blocks each, and the other ten have three blocks each. The two and three-block sides are placed alternately. In the two-block sides the horizontal joints go midway up the hearth wall, and in the three-block sides they are one-quarter and three-quarters up the hearth wall.

As originally designed, the hearth section was to have had 16 sides of equal width. However, some of the slabs from which the blocks were to be cut were damaged during the manufacturing process, and therefore the hearth was redesigned to use 10 blocks 16 in. wide and 10 blocks 22 in. wide.

The graphite blocks are bonded with a carbonaceous cement recommended by the block manufacturer. The plastic material was troweled on hot. Graphite staves, 2 in. wide and 1¼ in. thick, are set into slots at the outside of each of the vertical joints. A key, made of a graphite rod 1⅞ in. diameter, was provided at each horizontal joint. These keys are embedded in the joints 2 in. from the outer surfaces of the blocks. The staves and keys minimize leakage of gas if cracks should develop through the joints.

Reinforcing the Hearth

Openings for the two burner ports and the tapping slot are centered on vertical joints between the graphite blocks. Rammed carbon paste bond

How to Make Fused Tricalcium Phosphate

Fused tricalcium phosphate fertilizer was produced experimentally by TVA from 1945 to 1954 in two 60-ton-per-day furnaces at Columbia, Tenn. Providing a furnace hearth section with a satisfactory life was the greatest of the many difficulties encountered in the operation of these furnaces. Of all the structures tried, a hearth section built of graphite blocks proved to be the best. Development of the graphite hearth completed TVA's work on the process.

Previous publications[2,3] give details of the technology of fused tricalcium phosphate production and describe the development of the process from the laboratory through the demonstration plant.

How the Process Works

The manufacture of fused tricalcium phosphate involves melting and defluorinating a mixture of phosphate rock and silica in the presence of water vapor. The chemical reaction may be represented by the following equation:

$$Ca_{10}(PO_4)_6F_2 + xSiO_2 + H_2O \rightarrow 3Ca_3(PO_4)_2 + CaO \cdot xSiO_2 + 2HF$$

Phosphate ore for furnace charge was obtained from mines located near the plant. The charge was prepared by briquetting a mixture of partially dried phosphate ore, or matrix, and phosphate sand, obtained by beneficiating the raw ore. Clay in the matrix served as a binder for the briquets.

A typical charge contained 26.9% P_2O_5, 37.9% CaO, 19.2% SiO_2, 3.8% Fe_2O_3, 6.0% Al_2O_3, and 2.7% F, dry basis. Briquets, at a moisture content of about 12%, were charged to the top of the furnace by skip car. The furnace, about 41 ft. high, was filled to a maximum depth of 35 ft.

Heat for melting the charge and water vapor for the defluorination reaction were provided by burning natural gas at the bottom of the furnace. Fuel oil was used before natural gas became available; the feasibility of using coal for fuel was demonstrated in a pilot plant. Best results were obtained when the fuel was burned with a slight deficiency of air.

A ring of sintered charge usually adhered to the brickwork at the top of the shaft, leaving an opening, called a "chimney," through which the charge descended and the combustion gases ascended. The size of the opening varied; most of the time it was between 2 and 4 ft. in diameter. The charge did not descend uniformly and continuously through the furnace; usually crusts formed at the top of the charge column and fell in at intervals.

Melt accumulated in the furnace hearth until it covered the burner port outlets and the combustion gases bubbled through the melt. The melt was tapped at intervals of about 30 min. into a trough where it was quenched and granulated with high-velocity water jets. Water and granulated product were discharged into a pit. The product was removed from the pit by a bucket crane and was piled in the storage area. After several days of storage the granulated material drained to a moisture content of about 7 to 10%.

The damp, granulated material was prepared for shipment by drying, grinding, screening and bagging. Prior to drying, the material was passed to a 1¼ in. screen to remove lumps. Oversize, which amounted to about 1% of the total, was material which froze around the taphole; this material was recycled to the furnace. Undersize was dried in a gas-fired rotary dryer and ground in a ball mill. The ground product, of which about 80% was −40 mesh, was packed in paper bags.

Recovering Fluorine

In the production of fused tricalcium phosphate, about 90% of the fluorine in the phosphate rock charged to the furnace was volatilized, mostly as hydrogen fluoride. About 2 tons of fluorine was volatized per day per furnace. The release of this fluorine into the atmosphere was undesirable and, moreover, the fluorine represented a potentially valuable byproduct.

To recover the fluorine, the furnace gases were passed through a dust collector and then through a tower containing about 200 tons of lump limestone.[4] The hydrogen fluoride reacted with the limestone to form calcium fluoride. Once per 8-hr. shift, 15 to 20 tons of the tower contents was withdrawn from the bottom and passed to a 6-mesh screen. The oversize, which consisted of partially reacted limestone, was recycled to the tower, along with fresh limestone. The minus 6-mesh material contained about 80% calcium fluoride. Some of this material was sold for use as metallurgical-grade fluorspar.

Process Requirements

The material, service, and labor requirements for making one ton of fused tricalcium phosphate from briquets are given in the table. These figures are based on production of 20,000 tons of material per year in a single furnace.

Materials and services	
Briquets, tons	1.08
Limestone, tons	0.10
Fuel, million Btu.	
for furnace operation	7.2
for drying product	0.6
Power, Kwh	180
Process water, thousand gallons	12
Maintenance materials, dollars	0.90
Bags, number	20
Labor	
Operating, man-hours	3.10
Maintenance, man-hours	0.85
Chemical control, man-hours	0.30

Labor, maintenance, and control costs were lower when two furnaces were operated at the same time—crews needed for one furnace could handle the operation of both

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the burner-port and tapping-slot castings into the graphite.

After assembly, the hearth was heated to bake the joints by means of a brick, gas-heated "oven" built inside the hearth. The hearth was heated over a period of about 11 hours until the outside surface had reached a temperature of 550 to 650 F.

The hearth section is reinforced with steel bands to enable it to withstand severe vibration and the shocks of stock slides. This steel reinforcement was designed so that it would impose a minimum of interference to the flow of water over the hearth wall. Special attention was given to the plates that bore directly on the wall. These bearing plates are made in a streamlined, boat-like shape so that the water flows smoothly around them (see detail in the drawing).

Each of the bands is made of two semicircular segments to facilitate assembly. Special connectors, each of which consists essentially of a pair of spring-loaded bolts, join the two halves of the bands. While the hearth was cold the spring-loaded bolts were drawn up so that each of the bearing plates bore snugly upon the blocks. Expansion of the hearth during operation placed the bands under tension. Steel members welded to the bands serve to hold the burner-port and tapping-slot castings in place.

The base of the hearth section is anchored firmly to the concrete foundation to minimize vibration. Because the graphite wall does not have sufficient strength to support the rest of the furnace, the portion of the furnace above the hearth is supported by the steelwork that surrounds the furnace. A special seal is provided at the joint between the hearth and the middle section (see detail in the drawing).

Two sections of cooling coils made of copper tubing were embedded in carbon paste, adjacent to the steel shell in the 8 ft. of the furnace wall immediately above the hearth section. Firebrick lines the middle and upper sections, including the embedded cooling coils.

How Furnace Performed

The graphite hearth stood up very well in the 17 months it was in use. Except for worn spots above the burner ports and the taphole, wear on the graphite blocks was negligible.

Throughout the period of operation there was leakage of gas through the joints between blocks, around the taphole and burner ports, and through the joint between the hearth and middle sections. Although the leakage was not serious, it was evident, toward the end of operation, that repairs would be needed soon.

Despite the severe vibration and bumping that occurred at times, only two small cracks appeared in the graphite blocks. These cracks occurred at the inherently weak points where blocks were cut out to receive the burner ports and tapping slot. Of the six blocks that had such weak points, only two showed cracks during operation.

There was a definite contrast between the conditions of the hearth and middle sections after 17 months of operation. The firebrick lining in the middle section was badly deteriorated, and in a few places was worn through to the carbon paste lining. The exposed copper cooling coil that covered the juncture between the hearth and the middle sections began leaking after 7 months of operation. Flow of water to the coil was cut off, and furnace operation was continued without water. One of the two copper cooling coils embedded in carbon paste in the middle section failed after 8 months, and the other after 12 months. The use of these coils also was discontinued as they failed.

A film of water on the outside of the graphite wall kept the interior surface of the wall cooler than its ignition temperature. Above the level of the burner ports a 1-in. layer of molten material was frozen onto the wall. Below the level of the burner ports, a cup-shaped cavity was melted into the bed of briquetted charge that had filled the furnace when it was started. This cavity was lined with frozen melt. Molten material did not penetrate to the bottom of the furnace to any great extent.

Some Definite Advantages

The performance of the furnace with the graphite hearth was similar to that of the previous furnaces when they were in good repair. The several furnaces used about the same amount of fuel and produced fused tricalcium phosphate at about the same rate. The furnace with the graphite hearth, however, required less maintenance than any of the previous furnaces.

Besides the ability of the graphite to withstand operating conditions better than the linings of previous hearths, the graphite hearth could be repaired from the outside. Repairs to previous furnaces with internal cooling coils had to be made from the inside. The necessity for digging out the furnace burden to make repairs and the prolonged shutdown increased considerably the cost of maintenance of those furnaces.

To keep down the cost of revamping existing equipment, the designer often has to make compromises he would prefer not to make . In designing the graphite hearth it was necessary to limit the height to that of previous hearths to avoid extensive changes to the upper portion of the furnace. It would have been desirable to have the graphite wall about 20 ft. high. A graphite wall of such height would have encompassed the regions in which operating conditions are most severe, and the contrast in the final conditions between the hearth and middle sections would have been avoided.

Objectives Are Met

The objectives that were originally set for the project have been reached. Most major technical problems connected with production of fused tricalcium phosphate have been solved, and the agronomic value of the product has been fairly well established.[5,6,8]

L. H. ALMOND, *with TVA since 1936, has played a major role in the design of phosphorus furnaces and phosphoric acid units. Mr. Almond has been chief of the chemical plant design branch since 1942. He received a B.S. degree in mechanical engineering from Ohio Northern Univ. in 1916.*

W. L. ALBRECHT *joined TVA in 1940, where he worked in the chemical plant design branch until he entered the Navy in 1943. Returning in 1946, he took up patent work, studying law at night. He has a B.S. (Ch.E.) from the University of Wisconsin, and a LL.B. from the Jackson (Tenn.) College of Law.*

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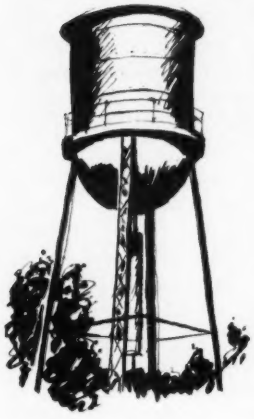
WATER

. . . for Processes
. . . for Cooling
. . . for Boilers
. . . for General Use



26,000,000,000,000 gallons a year for American Industries—None of it pure H_2O . . .

. . .What It Contains

ESKEL NORDELL, The Permutit Co., New York

AMERICAN industries in a single year use 26 trillion gal. of water, less than 10% of which comes from municipal supplies. So, over 23 trillion gal. must come from industry's own water supplies. None of this water, municipal or private, is chemically pure H_2O. All natural waters, even those of meteoric origin—rain, snow, sleet and hail—and all treated municipal supplies, contain impurities.

Some impurities, such as sediment, turbidity, color, algae and other suspended insolubles, are visible. Others, such as hardness, sodium salts, silica, ferrous and manganous bicarbonates, together with the dissolved gases, are soluble and colorless, and therefore invisible. But whether visible or invisible, the impurities in industrial water are potential trouble makers which can increase labor and maintenance costs and impair the quality of finished products. How far such troubles may arise due to the kind and quantities of impurities present generally has to be determined for each specific end use, and the tolerances for each use.

Quantities of impurities present in different waters vary greatly. The soluble mineral impurities in fresh waters range from less than 30 ppm. to over 2,000 ppm. Seawater contains 35,000 ppm. of which 27,000 ppm. is common salt. Connate waters and other natural brines may go as high as 250,000 ppm. of soluble salts, or even higher.

As regards the insoluble impurities such as turbidity and sediment, these range from practically zero in most ground waters, and some surface waters, up to as high as 60,000 ppm. in very muddy and turbulent river water. Furthermore, turbidity of a surface water may vary by as much as a factor of 100 or more during the course of the year.

YOUR FRESH WATER supply may contain

Soluble Impurities:

Cations: Calcium, magnesium, sodium, potassium, aluminum, iron, manganese, hydrogen.

Anions: Bicarbonate, sulfate, chloride, silicate, carbonate, nitrate, fluoride, sulfide, hydroxide.

Acids: Sulfuric, carbon dioxide, hydrogen sulfide.

Gases: Oxygen, nitrogen, carbon dioxide, hydrogen sulfide, methane.

Other Impurities:

Sediment, turbidity, color, algae, microorganisms, tastes, odors.

YOUR TREATMENT may range all the way from nothing at all, through simple settling or filtration, coagulation, aeration or deaeration, through chemical or ion exchange softening, to complete demineralization.

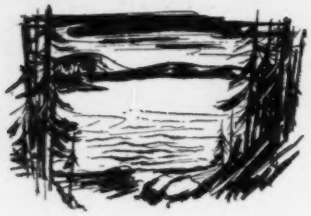
Soluble Mineral Impurities

Calcium, magnesium and sodium cations, and bicarbonate, sulfate and chloride anions, are the principal soluble mineral impurities in water. Other impurities that may be present in much smaller amounts are potassium and aluminum cations, and silicate anions. Some waters may also contain appreciable quantities of ferrous, manganous or hydrogen cations, as well as carbonate, nitrate, fluoride or sulfide anions.

Sometimes it is convenient to consider these as ions, and at other times as if they were present as compounds. In ion exchange work they are of course considered as dissociated ions, but it is convenient to think of the bicarbonate content to be bound first to calcium, then to magnesium, and finally to sodium as the bicarbonates are removed by heating and precipitation. This is established by the increasing order of solubility of the carbonates.

In water treatment it is usual to

How Turbidity Varies



Typical Lakes

Lake, Sampled Near	Turbidity, ppm. Max.	Min.	Avg.
Cayuga..... Seneca Falls, N. Y.	100	0	5
Erie..... Buffalo, N. Y.	250	4	12
Erie..... Erie, Pa	72	2	13
Erie..... Monroe, Mich.	1,250	10	84
Michigan..... Evanston, Ill.	75	4	12
Michigan..... Michigan City, Ind.	80	3	14
Michigan..... Sheboygan, Wis.	190	3	4
Superior..... Marquette, Mich.	3	0	—

Dissolved mineral content of large lakes remains relatively stable.

express most of the soluble components as calcium carbonate equivalents. Among these are total hardness, calcium, magnesium, sodium, bicarbonate, carbonate, hydroxide, chloride, sulfate, nitrate, methyl orange and phenolphthalein alkalinity, and mineral acidity. The exceptions are free CO_2, iron, managanese and fluoride, which are expressed as such, and alumina and silica, expressed as Al_2O_3 and SiO_2, respectively. Hydroxides of calcium, magnesium and sodium do not occur in natural waters, but are of interest since $Ca(OH)_2$ is often used in water treatment, while the hydroxides of magnesium and sodium are formed in steam boilers from the corresponding alkalinities.

Hardness—Hardness is due to and proportional to a water's content of soluble calcium and magnesium salts. In the U. S. it is expressed as calcium carbonate equivalents in either grains per U. S. gal. (gpg.), or in parts per million (ppm.). Here 1 gpg. = 17.1 ppm. = 0.143 lb./M gal. Hardness is of two types, carbonate (also called bicarbonate or temporary) hardness, due to the calcium and—if present—magnesium alkalinity; and non-carbonate hardness, due to the sulfates, chlorides or nitrates of magnesium or calcium. This is also called sulfate or permanent hardness.

As we shall see later, hardness is very objectionable because heating or evaporation precipitates hard, stony scale deposits which clog fluid systems, reduce heat transfer through metal surfaces and may cause overheating and extensive damage to the metal. The hardness may also cause objectionable precipitates with various alkaline materials. In equipment such as heaters and cooling jackets, where the water is heated but not evaporated, the principal scale former is calcium carbonate. In boilers the principal scale formers are calcium carbonate, magnesium hydroxide, calcium sulfate and silica.

Sodium and Potassium Salts—Sodium and potassium salts found in natural and treated waters are extremely soluble and do not deposit unless very highly concentrated.

Iron—In iron-bearing ground waters the iron is usually present as the colorless ferrous bicarbonate. Such waters when first drawn are clear and colorless, but the iron salt is oxidized on standing in contact with the atmosphere, forming the yellowish to reddish-brown insoluble ferric hydroxide. Such waters are therefore very objectionable, staining everything they contact. Furthermore they favor the growth of clogging masses of iron bacteria. Iron-bearing waters containing organic matter—usually surface waters—generally have part or all of the iron in chelated form, which does not oxidize readily. Acid waters usually contain their iron as ferrous sulfate, with some perhaps present as suspended, insoluble ferric hydroxide. Oxygen-carrying corrosive waters—red waters—contain iron as suspended ferric hydroxide.

Manganese—Although manganese is rarer than iron in waters, it is found in much the same forms—as manganous bicarbonate in ground waters, in chelated form in some surface and ground waters, as manganous sulfate in acid waters. It is less readily oxidized than iron, requiring higher pH, and its deposits are grayish to black, often masked by ferric hydroxide which is generally present also.

Silica—Almost all natural waters contain silica, from as little as 1 ppm., to rarely over 100 ppm. It is seldom troublesome except in boilers where it forms a variety of silica scales; at the temperatures of high-pressure boilers, it passes over with the steam and forms glassy deposits on the turbine blades.

Aluminum—Aluminum is usually present in such small amounts that it is not determined in industrial water analyses. Waters that have been properly coagulated with alum will generally have less than 1.5 ppm. Al_2O_3.

Mineral Acidity—Mineral acid, usually sulfuric, is a constituent of many mine waters, as well as surface waters contaminated with mine drainage or trade wastes. Such waters also generally contain ferrous and aluminum, and frequently manganous, sulfates. Ferric hydroxide may be present. These waters are very corrosive. Often any treatment except neutralization will be prohibitively high in operating cost.

Typical Rivers—How Turbidity and Hardness Vary

River, Sampled Near	Turbidity, ppm. Max.	Min.	Avg.	Hardness, ppm. as $CaCO_3$ Max.	Min.	Avg.
Allegheny, Kittanning, Pa.....	65	2	21	90	26	47
Arkansas, Ark. City, Kan.....	27,500	14	2,230	473	238	336
Delaware, Lambertville, N. J.....	90	1	16	61	24	44
Hudson, Hudson, N. Y.....	39	4	13	89	45	69
Illinois, LaSalle, Ill.....	1,610	10	159	277	157	215
Lehigh, So. Bethl., Pa.....	50	1	14	105	26	59
Mississippi, Memphis, Tenn.....	1,600	170	556	184	108	139
Missouri, Kansas City, Kan.....	5,350	35	1,910	348	159	229

Dissolved Gases

Oxygen and nitrogen are present in surface and aerated waters, and waters from pneumatic tanks, but absent or low in deep well waters. Nitrogen is inert but oxygen is very corrosive, especially to iron, zinc and brass. Free carbon dioxide is common in natural waters, varying widely in amount. Bicarbonates break down to form it, while the carbonates of magnesium and sodium produce it in steam boilers. The pH of most natural waters depends on the ratio of free CO_2 to methyl orange alkalinity.

Other dissolved gases may include H_2S (as well as alkaline and alkaline earth sulfides) found in the so-called sulfur waters; and methane found occasionally in ground waters.

Other Impurities

Sediment, turbidity, color, organic matter, microorganisms, tastes and odors are common impurities in surface waters. In ground waters they are absent or low in quantity. Exceptions are well waters colored from overlying peat beds, and the sulfur waters. Some deep-well waters contain ferrous or manganous bicarbonates and although clear when first drawn, become turbid and deposit highly colored precipitates on standing in contact with the atmosphere.

Turbidity and Sediment—Turbidity is suspended insoluble matter and sediment is coarse, suspended particles which drop out rapidly on standing. Turbidity may vary greatly from source to source, and throughout the year in the same source. It changes rapidly and often in flowing streams, but more slowly, and usually seasonally, in lakes, ponds and reservoirs. Location and depth of intake, currents and surface disturbances may cause wide variations, especially in lakes.

Color and Organic—Surface waters from swampy areas often are highly colored from decaying vegetation. Colors are measured in comparison with color standards. A color of 10 ppm. will not show in a tumblerful but can be seen when viewed lengthwise in a Nessler tube. Color of 20 ppm. is visible in a tumblerful. Color may vary greatly throughout the year.

Various organic growths occur in surface water, but seldom in uncontaminated deep-well waters. Most such microorganisms are non-pathogenic, but water must not be assumed safe simply because it is clear and colorless. Algae, iron and manganese "crenothrix," sulfur bacteria and other organic growths may be very troublesome in blocking flow and imparting obnoxious tastes and odors. These latter characteristics, except in sulfur waters, usually come from decaying organic matter or trade wastes, or from chlorinated organic matter in chlorinated waters.

How Color Varies

Typical High-Color Surface Waters

Water, Sampled Near	Color, ppm. Max.	Color, ppm. Min.
Calumet River..... E. Chicago, Ill.	120	15
Edisto River..... Charleston, S. C.	300	60
Great Dismal Swamp... Eliz. City, N. C.	1,200	150
N. New River Canal.... Ft. Lauderdale, Fla.	360	160
Roanoke River..... Randolph, Vt.	60	5

Water Uses

Water uses in process industries can be classified broadly into the following: (1) Process, (2) cooling, (3) boiler, and (4) general purpose.

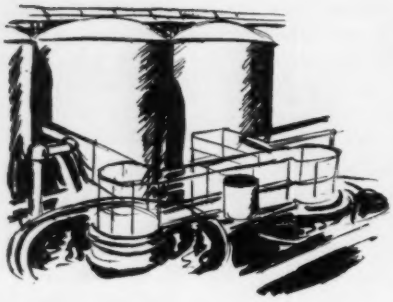
Sometimes the water is suitable without treatment, but if it contains undesirable constituents in troublesome amounts, then these should be removed or reduced to allowable tolerances by proper treatment.

The first step in considering what water treatment or treatments may be advisable is to make a thorough survey of both the water supply and its plant uses. If the water supply is a private one drawn from wells, then separate analyses of the water from each well should be made and information collected as to how the well pumps are operated. If the private supply is drawn from a surface source, then a series of analyses should be made and records searched to find what variations in composition can be expected. In some plants, both surface and ground water supplies are either in use or available. Then, studies of both should be made. Also the possibility of reuse of waste water should not be overlooked. If the water is obtained from a municipality, its records should be studied so as to find the maximum and minimum amounts of impurities which might be encountered over a yearly period.

In general, water from a given deep well is fairly uniform in composition year in and year out, although there are exceptions. This, however, is not a guarantee that water from another well—even if at the same depth and less than 100 ft. away—will have the same composition. In some well fields, the wells may all have water of approximately the same composition. In others, they may vary so greatly that there would be an appreciable difference in the composition of the mixed raw water depending on which wells were being pumped.

With surface waters, unless they are from a very large lake or reservoir, they tend to vary greatly in composition during the year. In most rivers, the content of dissolved mineral matter will have a maximum during the year two to three times as large as the minimum. In some it will range up to eight or more times as large. The tables show some typical variations of hardness as well as turbidity in rivers and lakes over a 1-year period.

In large lakes and reservoirs turbidity may vary over a wide range but the content of soluble mineral salts shows little or no change year in and year out. Small ponds, lakes and reservoirs may change in composition during the year but such changes are usually gradual.



Process Waters

General specifications for practically all process waters are that they should be free from (1) sediment, (2) turbidity, (3) color, (4) iron, (5) manganese and (6) hydrogen sulfide. In addition, most of them should be free from or low in organic growths and many of them should be free from objectionable tastes and odors. Specific tolerances on the first six items include:

1. Sediment—none.
2. Turbidity—less than 5 ppm. for high grade products and not more than 20 ppm. for lower grade products.
3. Color—less than 10 ppm. for high grade products and not over 20 ppm. for lower grade products.
4. Iron—not over 0.1 ppm.
5. Manganese—not over 0.05 ppm.
6. Hydrogen sulfide—none.

Organic growths are best eliminated from all of the plant water. Tastes and odors, if not too strong, may be tolerated in some lower grade process waters but in others they may be adsorbed by the product, which is especially the case with paper and various other fibrous or adsorbent materials.

Losses of Alkaline Materials by Reaction With Water of 20 Gpg. Hardness

Material	Loss, lb./M gal.
Soap	30.0
50-50 soap-soda ash	36.3
Soda ash	3.03
Sal soda	8.17
Caustic soda	2.29
Tri-sodium phosphate	7.24
Sodium meta-silicate	6.06

Hardness—Hardness is such an objectionable constituent that it is removed by softening from process, wash and rinse waters used for literally thousands of different purposes. Obviously it is impractical to detail either the difficulties caused by hardness in all of the many uses, or the results and savings accomplished by softening various waters. However, it is possible to sketch very briefly some of the objectionable properties of hard waters and ways to overcome them.

Briefly, waters containing appreciable amounts of calcium alkalinity can (1) form scale when warmed, boiled or concentrated. This scale clogs water heaters; chokes pipe lines, fixtures, nozzles, recirculation equipment; lines processing tanks in which it has an unfortunate habit of shelling off in chunks; leaves insoluble films, spots and streaks on processed materials; contaminates many materials or articles processed in hard water, often lowering their grade and increasing rejects and reruns; and increases costs for labor, repairs and replacements.

Hard waters also (2) react with alkaline solutions such as soda ash, caustic soda, sodium phosphate and silicate, hydrated lime, ammonia, soaps, rosin soaps, wasting chemicals and forming precipitates which cut down flow rates, and often adhere to and lower the quality of the materials being processed. If the calcium hardness is much above 2 gpg. (34 ppm.), the addition of soda ash, caustic soda, hydrated lime or ammonia will cause the formation of adherent scale and films with the attendant troubles listed above. Hard water is especially troublesome in all washing or scouring operations in which soap is used, since the insoluble calcium and magnesium soap curds formed are both bulky and sticky.

Hard waters are often troublesome (3) in making various emulsions, since the divalent calcium and magnesium cations (and, if present, the divalent sulfate anion) have a tendency to break emulsions. Also (4) in processing certain other colloids, such as clay, the same ions have a coagulating effect which lowers the plasticity of the mix.

In electroplating (5), hard waters often cause difficulties in cleansing and rinsing operations; form precipitates in alkaline baths; and often deposit calcium sulfate on concentrating in acid baths. Also, (6) high calcium and magnesium alkalinities are objectionable in certain fermentation processes, such as the brewing of light colored beers.

Among softening processes employed for process, wash and rinse waters, the most widely used one is

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ESKEL NORDELL

NEXT MONTH Mr. Nordell will bring you "Water—How It's Treated," a comprehensive article on water conditioning processes, chemicals used, operating costs, and other data. Processes to be covered in the second article will include:

1. Sodium cation exchange
2. Hydrogen cation exchange
3. Ion exchange demineralization
4. Cold lime-soda process
5. Hot lime-soda process
6. Coagulation, settling, filtration
7. Aeration
8. Deaeration
9. Iron and manganese removal

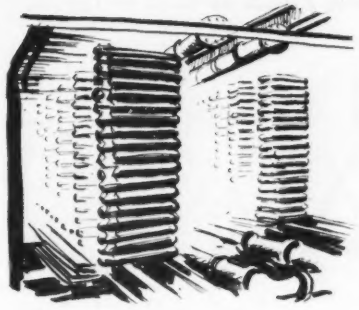
the sodium cation exchange (or zeolite) process. The next is the cold-lime or lime-soda process which is used for waters in which all that is required is lowering of the carbonate hardness to 2 to 4 gpg.; or lowering the calcium hardness to some 2 gpg.; or where some other degree of partial softening is sufficient.

The hot lime-soda water softening process is limited in its applications to a very few process waters which are to be used hot. The hydrogen cation exchange process is also somewhat limited in its applications being mostly used with waters containing sodium alkalinity. Of course, it is very widely employed as the first step in the ion exchange demineralization process which is used for removing not only hardness but all dissolved mineral matter as is briefly mentioned below.

Dissolved Mineral Matter—For many processes, the water used should be free from dissolved mineral matter. Due to its very much lower costs and its uniformly high quality, water demineralized by ion exchange is widely displacing distilled water for such purposes. Also it is coming into many new uses where distilled water had previously been considered impractical due to its relatively high costs.

Demineralized water does not contaminate materials processed in it; as a final rinse water it removes soluble salts; it does not leave residues of mineral matter when it evaporates; it does not produce precipitates when mixed with certain water-miscible solvents; it does not coagulate various colloids nor break various emulsions; it does not deplasticize clay and, to the electric current it opposes specific resistances ranging as desired from 100,000 up to 18,000,000 ohms per cc.

The following is a brief list of some of the plants, processes or products where demineralized water is used: anodizing, biologicals, breweries, catalysts, cellulose, ceramics, chemicals, cosmetics, dielectrics, distilleries, dyestuffs, electric batteries, electrochemical processes, electroplating, emulsions, enameling, explosives, extracts, gelatine, glass, humidifying, laboratories, paints, paper, perfumes, peroxides, pharmaceuticals, photographic products, plastics, soaps, synthetic detergents, synthetic fibers, textiles and uranium.



Cooling Waters

Specifications for cooling water vary over a rather wide range depending not only on (1) composition of the raw water but also on (2) where it is to be used, (3) what temperature it will reach, and (4) whether it is to be used once and then run to waste, (5) used in one or more locations for cooling and then used for other purposes, (6) recirculated in an open system or (7) recirculated in a closed system. A muddy river water, for instance, may be satisfactory without any treatment for once-through-and-to-waste use in surface condensers for steam. Very often, in fact, the sediment present scours the inside of the condenser tubes and keeps them mirror bright, but such a water would be unusable for practically any other cooling purpose.

Other once-through-and-to-waste cooling waters may require nothing but chlorination or a slight dosage of a polyphosphate. Recirculated cooling waters or cooling waters which are to be used later for other purposes require treatment which may be reduction or neutralization of most of the bicarbonate hardness; partial or complete softening; reduction of dissolved oxygen content; or addition of corrosion inhibitors or formation of protective films. For cooling purposes in certain electrochemical processes or for cooling such critical equipment as a Cyclotron, for example, completely demineralized water is required.

Where seawater is used for cooling, chlorination is usually the only treatment needed. The same is true with many fresh surface waters which are low in bicarbonate hardness. With waters higher in bicarbonate, the bicarbonate hardness may be reduced with lime. Finally, since calcium sulfate is over 100 times as soluble as calcium carbonate, and magnesium sulfate is extremely soluble, almost complete neutralization with sulfuric acid may be employed. Blowdown sufficient to keep the calcium sulfate content from rising above 100 gpg. is then practiced.

With waters which are used one or more times for cooling and then used for other purposes, complete softening is usually employed. Waters which are to be recirculated through a cooling pond, or cooling towers, should have the bicarbonate hardness reduced to not over 4 gpg., plus the addition of a small amount of sulfuric acid.

Where a very thin calcium carbonate scale is desired to protect ferrous metal against corrosion, the Langelier Index, which is calculated from the pH, calcium hardness, total alkalinity, total solids and temperature to which the water will be heated, is of value as a guide in adjusting dosages. Metal inserts or removable lengths of pipe can be inserted at strategic points so that periodic examinations of these will indicate whether or not further adjustment of dosages is needed.

Cooling waters which are to be recirculated in a closed system are usually softened to practically zero hardness and, in some cases, are demineralized. Chromate is frequently used as a corrosion inhibitor while on others, vacuum deaerators are employed. Demineralized water is also used as cooling water in some electrochemical processes so that, if a leak occurs, the cooling water will not introduce unwanted electrolytes into the baths.

Boiler Waters

Specifications for boiler feedwater depend largely on the operating pres-

Water Conditioning Processes Used in Typical Process Industries

Industries	Na-Cat. Ex.	H-Cat. Ex.	Demin'n.	Cold L. S.	Hot L. S.	Filtration
Abrasives mfrs.	X		X		X	X
Acid plants	X					X
Air products plants	X	X	X	X		X
Alcohol distilleries	X		X	X	X	X
Alkali works	X		X		X	X
Aluminum companies	X	X	X	X	X	X
Ammonia plants	X					X
Aniline works	X					X
Asphalt plants	X				X	X
Baking powder mfrs.	X					X
Barium products mfrs.	X				X	X
Batteries, storage, mfrs.	X		X			
Bleach mfrs.	X					X
Borax companies	X					
Breweries	X	X	X	X	X	X
Carbon products mfrs.	X			X	X	X
Catalyst mfrs.	X	X	X	X	X	X
Celanese mfrs.	X	X			X	X
Cellophane mfrs.	X					
Celluloid mfrs.	X					X
Cellulose, alpha, mills	X		X	X		X
Cellulose esters, mfrs.	X					X
Cement mills	X				X	X
Ceramics plants	X		X		X	X
Chemicals, fine	X		X	X	X	X
Chemicals, heavy	X		X	X	X	X
Corn products mfrs.	X	X	X	X	X	X
Cosmetics mfrs.	X		X			X
Cottonseed products mfrs.	X		X			X
Detinning plants	X					X
Disinfectant mfrs.	X					X
Drug houses	X		X		X	X
Dyestuff mfrs.	X		X			X
Elastomers mfrs.	X	X	X		X	X
Electrochemical plants	X	X	X		X	X
Electroplating plants	X		X		X	X
Enameling plants	X		X		X	X
Explosives mfrs.	X		X	X		X
Extracts mfrs.	X		X		X	X
Fertilizer plants	X				X	X
Fiberboard mills	X			X	X	X
Gas plants	X	X	X	X	X	X
Gases, liquid and compressed, mfrs.	X		X	X		X
Gelatine and glue plants	X		X			X

Industries	Na-Cat. Ex.	H-Cat. Ex.	Demin'n.	Cold L. S.	Hot L. S.	Filtration
Germicide mfrs.	X					X
Glass factories	X	X	X	X	X	X
Glucose mfrs.	X			X	X	X
Gypsum products plants	X	X			X	X
Hydrogen peroxide mfrs.	X		X			X
Ink mfrs.	X		X			X
Insecticide mfrs.	X					X
Leather: tanneries & artificial, mfrs.	X	X				X
Lime producers	X				X	X
Linoleum mfrs.	X				X	X
Lubricant mfrs.	X		X	X	X	X
Magnesium & magnesium products mfrs.	X			X	X	X
Match factories	X		X		X	X
Nitre, mines and plants	X					
Paint and pigment mfrs.	X		X		X	X
Paper mills, various	X	X	X	X	X	X
Pharmaceutical mfrs.	X		X		X	X
Phosphate mines and works	X				X	X
Photographic materials mfrs.	X		X	X	X	X
Plastics mfrs.	X		X			X
Potash companies	X	X				
Pulp mills	X	X	X	X	X	X
Rayon, mfrs. and mills	X		X	X	X	X
Refineries, edible oil	X	X			X	X
Refineries, petroleum	X	X	X	X	X	X
Refractories mfrs.	X		X			X
Rubber mills and factories	X	X	X	X	X	X
Salt companies	X			X	X	X
Soap factories	X	X	X		X	X
Solvents mfrs.	X		X	X	X	X
Soya products plants	X	X			X	X
Sugar refineries	X	X	X	X	X	X
Sulfur companies	X			X	X	X
Synthetic detergents	X	X	X		X	X
Synthetic fibers mfrs.	X		X			X
Tannin mfrs.	X	X				
Tar products companies	X				X	X
Titanium products companies	X					X
Tobacco byproducts mfrs.	X	X				X
Vaccine mfrs.	X					
Varnish and lacquer mfrs.	X		X			
Viscose plants	X		X		X	X
Wood extracts mfrs.	X	X			X	X
Zeolite mfrs.	X		X			X

sure. A low-pressure boiler may operate very satisfactorily on a softened water with a fairly high content of sodium salts, no reduction of the silica content and a deaeration to 0.3 ml./l. of dissolved oxygen.

A boiler operating at somewhat higher pressures might require softened water with a lower alkalinity, possibly some reduction of the silica content, and a deaeration to a residual of not more than 0.005 ml./l. of dissolved oxygen. At still higher pressures, silica residuals would be still smaller, residual oxygen not over the previously mentioned 0.005 ml./l. and the water would either be (1) completely softened with a low alkalinity and low total solids content or (2) completely demineralized.

Of course, boiler feedwater should be free from suspended solids, iron, manganese, hydrogen sulfide, oil and other foreign organic materials. So, if the raw water is not clear and free from these impurities, it should be clarified and freed from them, preferably ahead of other forms of treatment.

General Purpose Waters

General purpose waters, used for flushing, if fairly clear, may require little or no treatment, except perhaps chlorination. Those used for drinking should be clear, clean, colorless (preferably not over 10 or 15 ppm.), palatable and, of course, of approved bacteriological quality. Water for use in the washbowls and showers should meet the same standards as drinking water. In addition, if the water has more than a few grains of hardness per gal., at least the hot water supply should be softened. All water, both cold and hot, used in washwheels or for other washing, scrubbing and cleansing purposes should be completely softened.

Water Conditioning Processes

Water conditioning processes are very widely used in the chemical process industries. The table above lists a number of process industries and six of the water conditioning processes they use. These include sodium cation exchange, hydrogen cation exchange, ion exchange demineralization, cold lime-soda, hot lime-soda and filtration. This list is based on thousands of actual installations, but is probably not 100% complete.

These processes will be discussed in a second article [next month—*Ed.*] dealing not only with methods, but also chemical needs and costs.

BIO-OXIDATION

A CHEMICAL ENGINEERING REPORT—SEPTEMBER 1955

Disposal of organic process wastes is the chemical engineer's responsibility. It's high time, then, that he began taking a more active part in the development and design of bio-oxidation waste treatment plants.

Biochemical oxidation through the agency of living organisms is Nature's own method for disposing of organic wastes. As a process it's as old as life itself.

Modern civilization, however, with its highly localized concentrations of industrial and domestic wastes, has created disposal problems. The best scientific and engineering knowledge is needed for economic and successful solutions.

To the average chemical engineer there appears to be something mysterious about bio-oxidation. Possibly it's because the "sanitary" branch of civil engineering has traditionally monopolized the field. The chemical engineer can no longer be content with this situation.

Object of this report, therefore, is to interpret bio-oxidation processes in terms understood by chemical engineers.—ED.

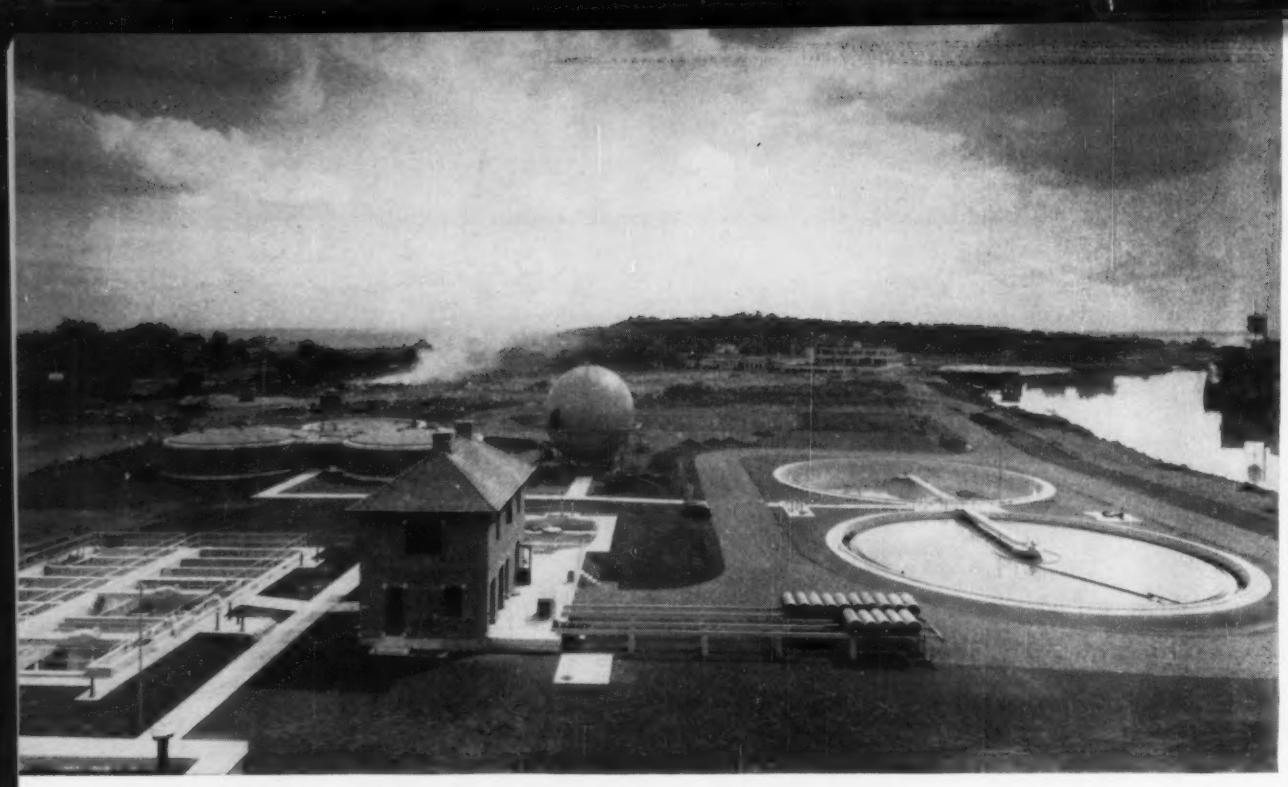
Your authors, writing specifically to engineers in the chemical process industries, present thirteen pages of bio-oxidation theory and practice.

W. W. ECKENFELDER, Jr.,

T. L. MOORE

W. WESLEY ECKENFELDER, Jr., is assistant professor of civil engineering at Manhattan College and a consulting process engineer. Trained and experienced in both chemical and civil engineering, he is well qualified to write about bio-oxidation. Included in his industrial experience were positions with General Chemical, as control chemist, and Atlantic Refining, as sanitary engineer.

THEODORE L. MOORE is supervising sanitary engineer for Gibbs and Hill, consulting engineers, New York. His most important assignment since joining that firm was design of water treatment facilities for the entire Savannah River AEC project. Previously he was chief of construction and maintenance for the Bureau of Mines' oil shale development plant at Rifle, Colo.



MANY problems in water pollution are attributable to organic wastes emanating from chemical processing operations, such as petroleum refineries, pulp mills, pharmaceutical plants, coke byproducts plants, distilleries, canneries and dairies.

Characteristics of some process wastes are shown in the table below. These wastes all contain organic matter which, if discharged into a receiving water, would deplete the oxygen content of the receiving water to a degree expressed by the BOD content of the waste.

Biochemical oxygen demand (BOD) is a measurement made in the laboratory of the estimated amount of dissolved oxygen removed from a receiving water and consumed by the oxidation of the organic matter introduced by the waste stream.

This definition implies, quite correctly, that bio-oxidation of organic matter occurs naturally in the river (or other body of water) into which the waste is discharged. In many cases the natural processes are entirely adequate. It's only when BOD content of the waste stream exceeds certain limits that "artificial" bio-oxidation is necessary.

Until recently the exact theory of bio-oxidation was not fully understood, and design of treatment plants was based mainly on empirical methods. Now, by the application of known bacteriological concepts to the biological oxidation of organic wastes, the process has been rationalized. It is now possible to design a bio-oxidation plant from fundamental considerations with as much confidence as normally placed in the design of any conventional process unit.

First job in any waste disposal study is to determine the tolerance of the receiving water for assimilation of various wastes. States, municipalities and other pollution abatement agencies may have already set standards.

A great deal of time and effort may be needed to conduct such a survey, but the information gathered is essential before the type and degree of treatment for a particular plant can be determined. Bio-oxidation installations aren't cheap, and they don't earn any return on the invested capital, so there's no point in spending money to do a better treatment job than is necessary.

Second step in solving a pollution problem is to set up and carry out a gaging, sampling and analysis program to determine flows and characteristics of the process wastes. Metering of wastes may be accomplished by weirs, orifices, nozzles and venturis, depending upon pressure, suitability of installation and character of liquid, with recorders used for complete flow information. Analyses of the wastes should be performed in accordance with the American Public Health Association's "Standard Methods."

Finally, before embarking on a program to develop data for treatment plant design, the process engineer will look for ways to reduce the pollution load by in-plant recovery.

This preliminary survey of process wastes, while important, is outside the scope of this report. For further reading, refer to an earlier report on "Pollution Control."[15]

Characteristics of Some Typical Process Wastes

	Suspended Solids, Ppm.	Five-Day BOD, Ppm.	pH
Kraft pulp (unbleached)	75–300	100–350	7.6–9.5
Pharmaceutical	.....	1,367–4,100	.....
Petroleum refinery (one location)	.....	1,815 (COD) (560 phenol)	8.8
Dairy	525–550	800–1,500	5.3–7.8
Cannery	20–3,500	240–6,000	6.2–7.6
Packinghouse	650–930	900–2,200	.....
Laundry	400–1,000	300–1,000	.....
Wool scouring	1,000–17,000	200–10,000	.....
Brewery	245–650	420–1,200	5.5–7.4

How Bio-Oxidation Is Put to Work

Based on same principles, two major processes differ quite markedly in engineering and equipment design.

PROCESSES & EQUIPMENT
BIO-OXIDATION THEORY
PLANT DESIGN

Techniques for bio-oxidation of water-borne organic wastes may be divided into two general categories. The oldest method is to pass the wastes through a stationary biological bed, or "trickling filter."

The second method is to pass the biological growths through the wastes. This process, called "activated sludge," was first proposed during the period of 1910-1920. Large activated sludge plants for sewage disposal were placed in operation between 1916 and 1926 at Houston, Milwaukee, Pasadena and Indianapolis.

As will be seen from considerations to be brought out later, design of activated sludge units involves less empiricism than design of trickling filters. This situation is resulting in much wider interest in the activated sludge process.

Trickling Filters

A trickling filter (see cut, p. 192) generally consists of a circular structure containing a bed of suitable depth of crushed stone, crushed slag or other reasonably hard and insoluble medium.

Wastes are deposited over the bed by rotary distributors or fixed nozzles. The liquid trickles downward through the bed to the underdrains and is there collected. Underdrains are usually precast vitrified clay blocks with suitable openings for drainage and ventilation. (Large suspended solids present in the waste are removed by primary settling before the waste is fed to the filter.)

The term "filter" is really a misnomer, although it is well established by many years' usage. The mechanism of operation actually involves adsorption rather than filtration.

As organic wastes are continuously passed over the medium a gelatinous film of micro-organisms—composed of microbial cells in various stages of activity, organic matter in various stages of decomposition, and oxidized and nonoxidizable organic and inorganic residues—develops on the surfaces of the medium. Colloids are adsorbed by the film, where they are coagulated and hydrolyzed to smaller molecules, and soluble organics diffuse into the film, where they are oxidized by enzymatic action.

Approximately 60% of the dissolved and colloidal organic matter removed from the waste stream via bio-oxidation goes into growth of micro-organisms (sludge), with the remaining 40% going to CO_2 and water to provide the energy for the life processes. In addition, the sludge itself can undergo continuous auto-oxidation.

The end products of the oxidation process and the nonoxidizable organics are rejected by the film back into the waste substrate passing through the bed. In such fashion, a dynamic equilibrium is established in the BOD removal-oxidation process.

The amount of biologically active growth on the filter medium is a function of temperature, organic loading to the filter, area of the supporting film surface and hydraulic loading to the filter. Organic loading per unit of bed volume can be increased when the waste has a high initial BOD.

As the sludge film in the bed increases in quantity via the growth processes, portions of the film continually slough off the surface of the medium and pass through the underdrains with the treated liquor. This action generally requires that the treated liquor go through a final settling step before disposal.

Biological filters may be designated as either standard or high-rate trickling filters. Usually a standard-rate filter operates with a load not exceeding 600 lb. BOD per day per acre-ft. of bed (0.37 lb. per cu. yd.), while a high-rate filter can exceed 1,600 lb. (1.0 lb. per cu. yd.). High-rate filters are further subdivided into single-stage or two-stage filters. In construction details, however, the two types are essentially the same. Main difference is that a larger feed pipe and a higher-capacity distributor will be required for a high-rate filter.

Time of contact of the waste with the microbial film is determined by the rate of downward percolation of the waste through the filter bed. This can be partially regulated by effluent recirculation and dosing uniformity. Greater BOD reductions can be obtained with effluent recirculation, since the organic content contacts the microbial film more than once. Time of contact through a high-rate trickling filter is 15-25 min.

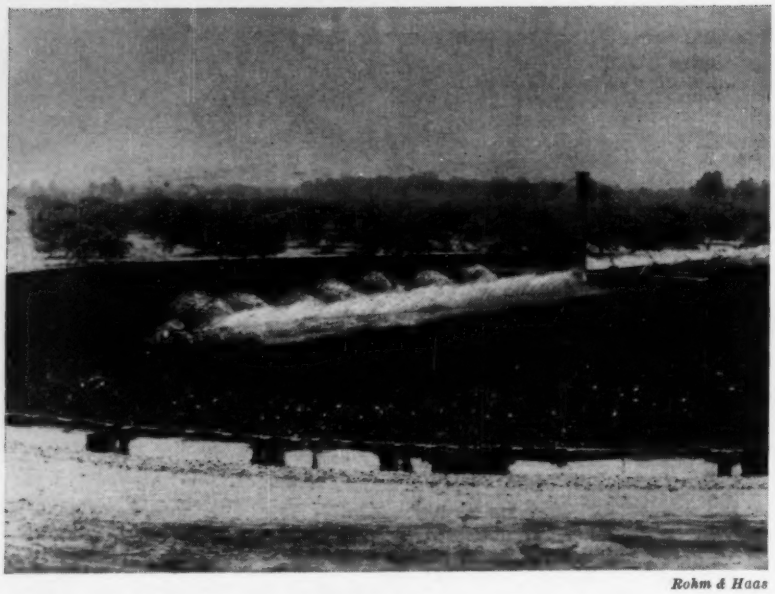
Low- and high-rate filters have been successfully employed for the treatment of sewage and organic industrial wastes. Over-all reductions of 90-95% of BOD content have been obtained in the treatment of sewage with loadings of 1 to 2 lb. BOD per day per cu. yd. of filter bed. An inverse linear relationship between loading and BOD removal has been observed to 6 lb. BOD per day per cu. yd.

Reductions of 97% at a loading of 0.93 lb. BOD per day per cu. yd. have been obtained on wastes from penicillin and streptomycin production. Aureomycin wastes yielded 40-80% BOD reduction with preaeration and filtration.

BOD reduction of 90% has been obtained on wastes from viscose rayon manufacture. Phenolic and formaldehyde wastes have produced 70-80% removal. Biological filtration combined with chemical treatment on wastes from cotton textile printing and finishing have given 90-95% over-all BOD reduction, with 60-70% reduction through the biological filtration step. Results on wool dyeing wastes were comparable with those obtained on domestic sewage filtration.

Greater than 90% BOD reduction has been obtained in the biological filtration of dairy wastes, and brewery

Trickling Filter Treats Chemical Wastes



Rohm & Haas

Typical Performance Data for Trickling Filters

Industry	Filter Depth, Ft.	Hydraulic Loading, Mgd./Acre	Recirculation Ratio	Applied BOD, Ppm.	BOD Loading, Lb./Yd.^{3}	BOD Reduction, %	Temp.
Chemical	6.0	4.4	10	1,800	0.63	94	Summer
Chemical	6.0	7.2	10	2,200	1.30	65	Winter
Pharmaceutical	4.0	15–20	10–23	3,110	3.34	56	Variable
Pharmaceutical	6.0	54	12	3,500	1.2	66	Variable
Pharmaceutical	6.0	78	18	4,100	1.6	78	Variable
Pharmaceutical	3.0	....	4	1,367	7.4	53	.....
Kraft mill	6.0	52	2.4	117	4.4	27	14 C.
Strawboard	6.0	17	10	820	1.24	54	27 C.
Distillery	8.0	25	3–5	675	1.97	60	.....
Distillery	6.0	6.4	4	700	0.75	93	.....
Distillery	...	30	11	685	1.10	77	.....
Dairy	4.0	15	13.5	1,160	1.42	92	20 C.
Sewage	4.4	16	1.86	184	1.22	83.4	Variable

and distillery wastes yielded 96.5% removal efficiency. Other similar plants gave 88% removal at a loading of 1.6 lb. BOD per day per cu. yd. and 99% removal at loadings of 0.75. Reduction of 50% was obtained on yeast waste filtration.

Treatment of packinghouse wastes on multistage filters gave over-all BOD reductions of 95%, and other packinghouse installations have yielded 94-98% reduction. Biological filtration of beet sugar wastes in Great Britain gave 90% BOD reduction, while pea, green bean and tomato wastes on high-rate filters gave 97% BOD reduction.

Shown above is a single-stage biological filter plant used by Rohm & Haas to treat chemical wastes. BOD reduction of 92-96% is obtained under summer temperature conditions from an initial BOD of 1,800 ppm. Hydraulic loading is 4.4 million gal. per day per acre (0.07 gpm. per sq. ft.) with a 10:1 recycle ratio and an organic loading of 0.63 lb. BOD per day per cu. yd. Nutrients in the form of ammonium nitrate and ammonium dihydrogen phosphate are added to the waste prior to filtration.

Some detailed performance data on various wastes are shown in the table. An excellent general discussion of biological filtration of industrial wastes has been compiled by Rudolfs and Heukelekian.[19]

Activated Sludge Process

The conventional activated sludge process differs from the trickling filter process in somewhat the same way as forced-convection heat transfer differs from natural convection. Whereas in the trickling filter the bringing together of waste, bacteria and air is dependent on gravity and other natural forces, the activated sludge process leaves nothing to chance. The biologically active sludge is added to the waste in a predetermined concentration and the mixture is agitated and aerated vigorously. (As in the trickling filter process, the waste is first separated from suspended solids by sedimentation.)

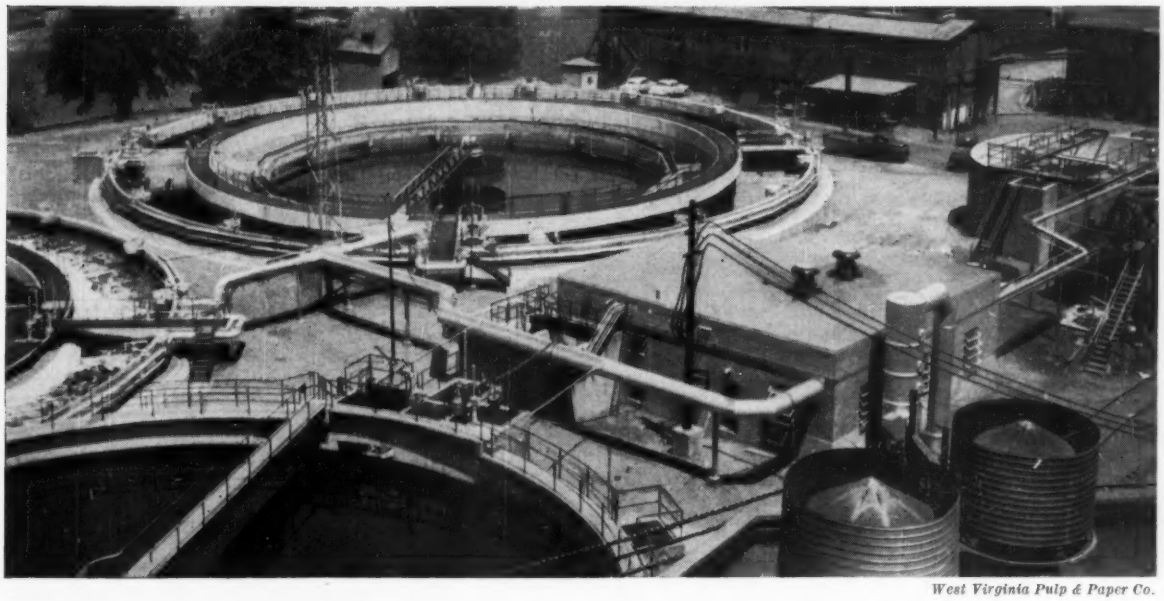
After mixing and aeration the sludge is separated from the treated waste liquor in settling tanks. Part of the sludge is returned to the inlet of the aeration tanks, and the balance, the net sludge formation, is withdrawn from the process for disposal by other means (as described later).

Sedimentation is accomplished in clarifiers of the rectangular or circular type. Aerator tanks are also rectangular or circular and sometimes are combined with the final settling units.

Compressed air is supplied to the aeration step in greater quantity than that needed for growth of the organisms; the excess provides sufficient agitation for intimately mixing the air, sludge floc and incoming wastes. Cross-sectional area of the aeration tank is determined by the required degree of agitation and contact time between the sludge and the organics in the waste.

An exemplary activated sludge plant for treatment of process wastes is that recently placed in operation by West Virginia Pulp & Paper Co. at Covington, Va. (see cuts at right).

Activated Sludge Process Treats Pulp and Paper Wastes



West Virginia Pulp & Paper Co.

Design Basis for Sludge Plant

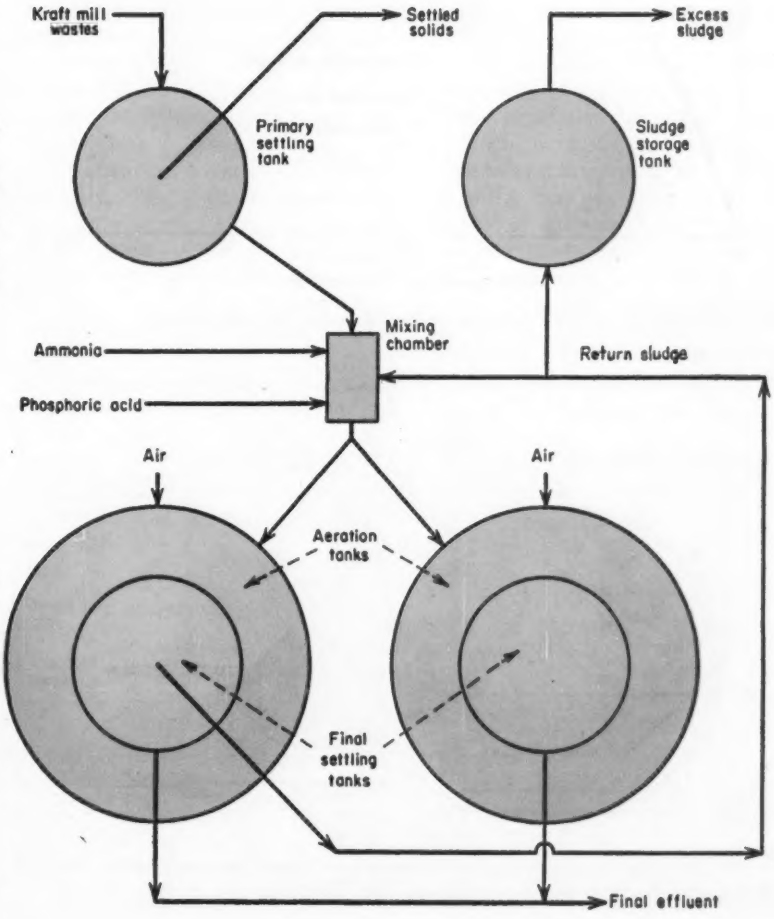
Primary Settling Tank →

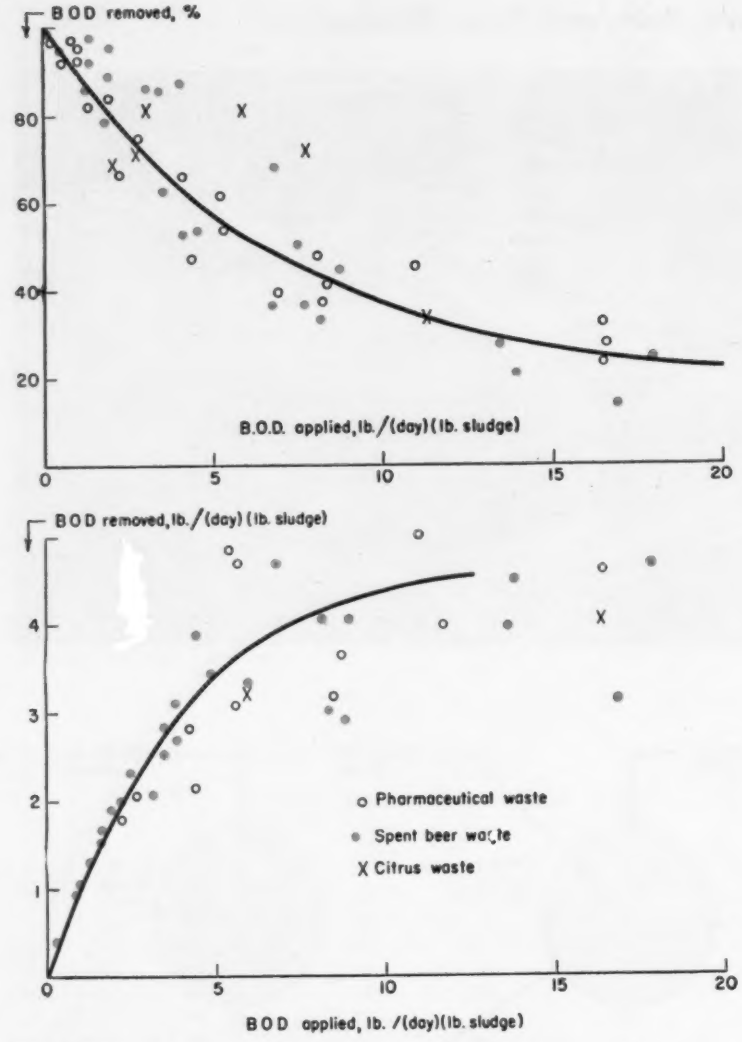
Waste flow, mgd.		8.0	
Influent susp. solids, ppm.	200	500	1,500
Approx. frequency, %*	10	50	90
Reduction, %	37.5	54.5	65.0
Detention, hr.		2.3	
Overflow, gal./(day)(ft.²)		1,020	
Sludge, lb./day	5,000	18,250	65,200
Sludge conc., wt. %		0.6 2.1	

Activated Sludge Process →

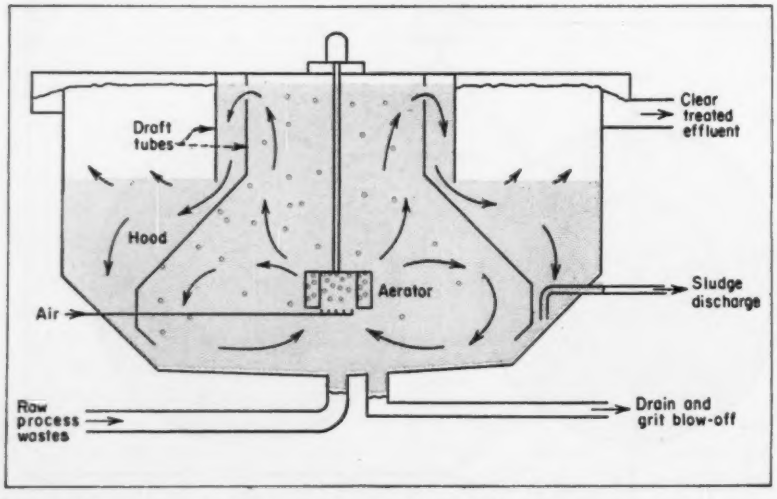
Flow, mgd.		16.0	
Influent BOD, ppm.	100	142	180
Approx. frequency, %*	10	50	90
Effluent BOD, ppm.	10	15	19
Reduction, %	90.0	89 4	89.5
Aeration detention, hr.		3	
Mixed liquor solids, ppm.		2,800	
O_2 requirement, lb./hr.	407	503	580
Excess sludge, lb./day	17,160	21,650	29,930
Nitrogen feed, lb./day	110	390	607
Phosphorus feed, lb./day.	72	116	157

* Percent frequency is the portion of time that the influent suspended solids or BOD is below the indicated value.





BOD REMOVAL data for activated sludge treatment of various wastes.



AERO-ACCELATOR is used in a high-rate activated sludge process.

Its principal units of process equipment are a 100-ft.-dia. primary sedimentation tank, two 175-ft.-dia., compartmented, reinforced concrete combination aerator-clarifiers, a 50-ft.-dia. excess sludge storage tank, outfall sewer dispersing system and nutrient feed system. Plant design was based on the criteria shown in the table.

Studies on the treatment of kraft process wastes for the Covington installation revealed that 90-95% BOD reduction could be attained at aerator loadings of 75 lb. BOD per day per 1,000 cu. ft. of aerator volume. These wastes contain complex organic compounds such as lignin, lignone, cyclohexenedione, carbohydrates and resins.

Conventional activated sludge treatment of domestic sewage has produced 90-95% BOD reduction.

The process has also been employed for the treatment of dairy, packinghouse, cannery, fermentation and other industrial wastes. Shown graphically at the left are BOD loading and removal efficiencies for batch treatment of pharmaceutical, spent beer and citrus wastes.

In recent years research in biological treatment has led to the development of several high-rate activated sludge processes. One of these processes, known as "biosorption" or contact stabilization, has been successfully employed in the treatment of domestic sewage and cannery wastes. BOD reductions of 90-94% from domestic sewage ranging from 200 to 320 ppm. have been reported.

In this process the waste is mixed for a short period of time with previously aerated sludge. The mixture of sludge and waste is then settled for about a 2-hr. period. From this stage the final clarified effluent is discharged.

The settled sludge consists of activated sludge floc along with occluded solids from the wastes. It is subjected to biological oxidation in an aerated tank for a period of 2 to 3 hr. Part of the aerated sludge is returned to the mixing tank for continuous mixing with the incoming waste and the excess is disposed of.

Another high-rate unit, known as the Aero-Accelator (see *cut at left*) combines aeration and final settling in one structure.

Raw waste enters the bottom of the unit, where it is mixed with re-

Typical Performance Data for Activated Sludge Plants

Industry	Process	BOD Loading, Lb./Day/ Lb. M.L.S.S.	Raw BOD, Ppm.	M.L.S.S., Ppm.	Aeration Detention, Hr.	Return Sludge, %	BOD Reduction, %
Pulp and paper	Conventional	0.30	183	2,910	3.85	33	91.2
Pharmaceutical	Conventional	1.60	1,556	3,292	3.75	100	89.0
Cannery	Conventional	2.56	630	2,500	4.8	....	81.6
Cannery*	Biosorption	1.28	600	3,220	3.0	100	84.0
Sewage	Conventional	0.228	153	2,050	6.34	35	90
Sewage	Aero-Accelator	2.08	132	530	2.92	20	67.5

* BOD loading to the aerator alone is 12.4 lb. per day per lb. sludge, composed principally of cellular storage.

circulating sludge and air. The mixture is aerated and dispersed for intimate contact with a large volume of activated slurry beneath the hood section. It then passes vertically upward in the center of the unit, from which it flows radially through adjustable ports. The sludge is dynamically separated from the treated liquor and recirculated to the bottom of the unit. Aeration is accomplished by impinging a flow of air from an open pipe against a rotating agitator.

The Aero-Accelator contains an inner and an outer draft tube, comprising approximately two-thirds of the total tank volume, through which the sludge is recirculated at a high rate. Oxygen transfer, through gas-liquid contacting, occurs only in one draft tube, which is approximately one-third of the total tank volume. Bio-oxidation is considered to occur throughout both draft tubes because of the high interchange of oxygen and sludge between the two tubes.

Disposal of Excess Sludge

Net sludge production from bio-oxidation plants, along with unoxidized material removed in the settlers, may be disposed of by one or more of these operations: Digestion, dewatering, filtration, drying or incineration.

Sludge digesters are usually concrete tanks with either concrete or steel dome roofs. Here the sludge is allowed to undergo the normal course of decomposition of organic matter by bacterial action in the absence of oxygen and in the presence of heat. End products of digestion are gas (rich in methane), liquor and inert burned-out core.

Depending upon the quantity and characteristics of the sludge and the intent of sludge gas utilization, digesters are designed for single or two-stage operation. In two-stage operation, agitation (to prevent stratification) and heat are provided in the primary unit, while neither is provided in the secondary. Total volume of the two tanks is the same as if only primary digestion were used.

Modern developments in sludge digestion and processing have recently been reported.[21] The most marked advance has been the concentration of sludge prior to digestion. This has resulted in appreciable reductions in digester tank volumes.

Recirculating digester gas through the sludge has given increased loadings and better mixing and has reduced scum problems. Interstage elutriation is being used for removal of toxic wastes and to clear up dirty supernatant return to primary settling tanks.

Pilot-plant work indicates that concentration by flotation prior to incineration is feasible. Advances in sludge filtration are primarily improvements in filter cloth and procedures in washing and use of less expensive chemicals.

Auxiliary Equipment

Air Supply—Blowers of the rotary positive-displacement or centrifugal types are generally used to provide air for the activated sludge process. Required pressure seldom exceeds 10 psi. Larger plants requiring 10,000-15,000 cfm. per blower usually use centrifugal blowers, while smaller plants use the positive-displacement type.

Inlet or exhaust snubbers are used in some cases on positive-displacement blowers to lower noise level and reduce metering difficulties.

Air filters may be installed on the suction side of the blowers; they usually are of the dry, viscous or electronic precipitator type. Maximum permissible quantities of dust in the filtered air may range from 0.5 to 1.0 mg. per 1,000 cu. ft.

Aeration Equipment—Successful application of the activated sludge process to waste treatment requires that the liquor-sludge mass absorb the requisite quantities of oxygen from the aerating gas. Proper design and selection of aeration equipment is thus highly important.

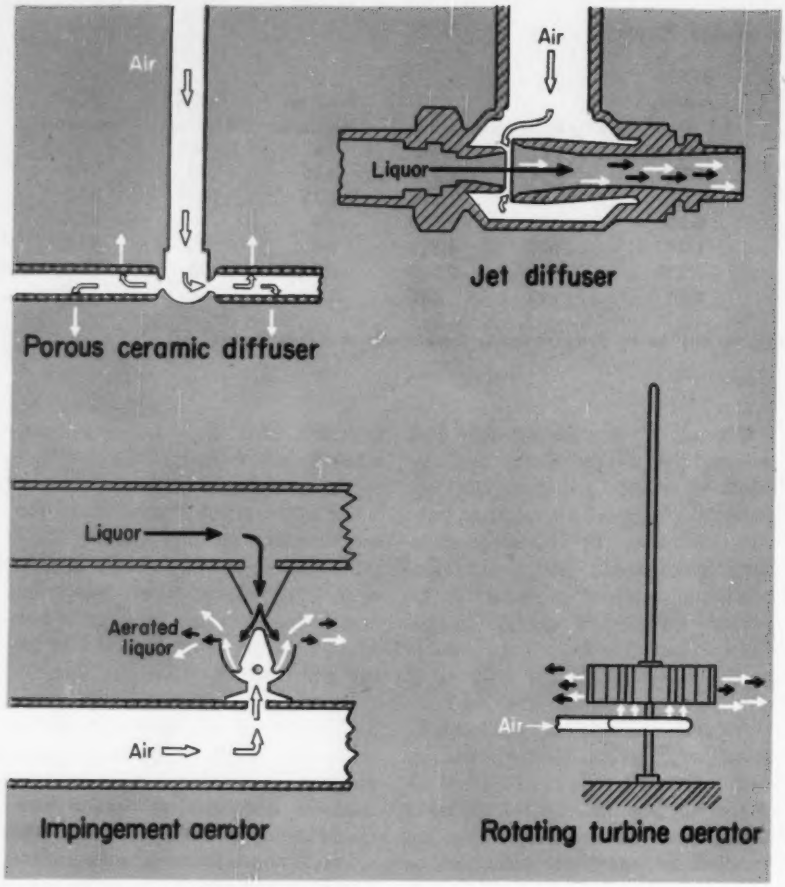
The most common type of aeration equipment employs porous ceramic spargers or "diffusers" in the form of tubes or plates. These units may be either permanently mounted in the bottom of the tank or suspended from the tank wall. Suspended units are usually placed 2 ft. above the tank floor. They are positioned so as to obtain good circulation or turnover of tank contents.

A minimum air flow of 3 cfm. per ft. of tank length (or circumference) must be maintained to insure adequate turbulence and avoid sludge deposition.

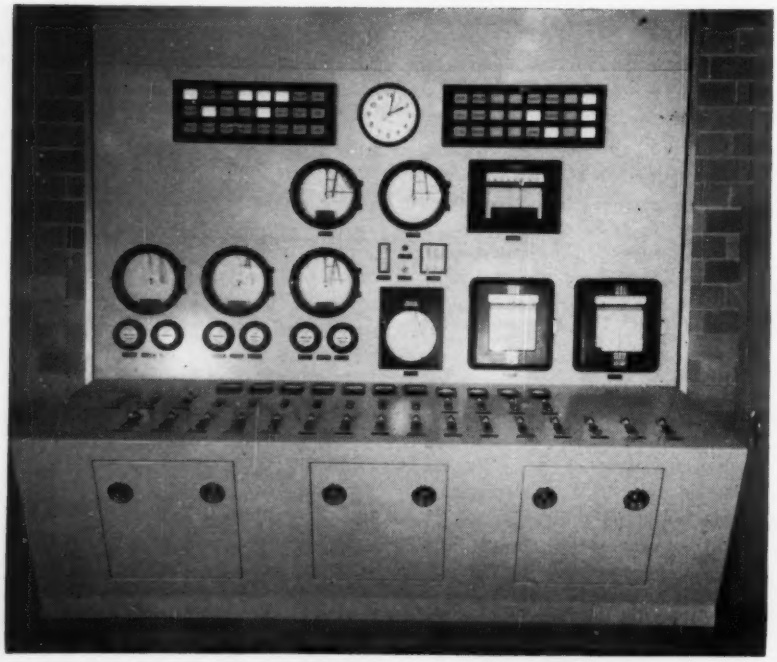
Porous diffuser units are rated according to permeability. Numerical rating is equal to the number of cfm. of air at 70 F. passed by the unit at a pressure loss of 2 in. water.

In jet diffusion, recirculating liquor is pumped through a multiplicity of ejectors, where it aspirates and disperses atmospheric air or disperses air supplied by a blower.

The impingement acrator uses an air lift to pump a circulating stream



AERATION of mixed liquor may be done with different types of air diffusers.



AUTOMATIC control of bio-oxidation plants minimizes operating labor.

of liquor from the tank. This stream is used to shear air bubbles discharged from a large orifice.

When the wastes have a high organic concentration, the rotating turbine aerator may be economically employed. In this unit gas bubbles are broken up by the shearing action of the blades of a high-speed rotating impeller submerged in the liquid.

Air may be admitted through a sparger ring at the turbine periphery or under its center. At low air flow rates the point of gas inlet has little significance, while at high rates better dispersion is attained when the air is admitted at the zone of greatest turbulence, i.e., the turbine periphery. The turbine draws less power when air is admitted under the impeller because of the decreased density of the liquid-gas mixture.

Final selection of aeration equipment for any particular application should be based upon an economic balance, considering capital investment, maintenance and power costs. Power costs frequently can be reduced by using dissolved-oxygen recorders to modulate automatically the rate of air flow to the system in direct response to the demand rate.[6]

Sludge Pumps—Pumps for handling sludge may be centrifugal, plunger or diaphragm type. Selection is based on characteristics of the sludge, quantity of flow and controllability.

Plunger and diaphragm pumps are used to handle highly concentrated solids and are particularly advantageous for proportionate control. However, centrifugal pumps must frequently be used because of capacity limitations of plunger and diaphragm types. Good results have been obtained with centrifugal pumps on proportionate flow by installing variable-speed motors and flow control metering.

Materials of Construction—Selection of the right materials of construction and protective coatings is important in the design of a waste treatment plant.[1] Inasmuch as large quantities of concrete are used, special consideration must often be given its protection from the corrosive and erosive effects of wastes. Additives and other means for producing a dense concrete and nonpermeable surface, organic barrier coatings, acid proof

brick linings and other such protective means are used for this purpose.

Also, proper consideration must be given to selection of metals used for piping, valves, pumps, blowers, collector mechanisms, etc. Corrosive conditions vary widely for different treatment plants.

Instrumentation and Control—Waste treatment plants can be designed to operate almost automatically. However, such duties as visual inspection and decisions of judgment and experience require personal attendance. The degree of automatic control which is desired must be determined for each specific plant.[6]

Metering of liquid and air flows is more or less conventional, although special consideration must be given such variables as viscosity, temperature, suspended solids and corrosive conditions which affect the differential producers. Gaging equipment for liquid and solids levels and instruments for force, pressure and electrical measurements require thorough understanding of their uses to make proper selection.

Operating control measurements may be obtained by pH, conductivity and temperature meters. Recent instrument developments merit consideration of dissolved-oxygen recorders and instruments for measuring density and viscosity.

What Happens During Bio-Oxidation

Organic matter provides food for metabolism of the micro-organisms, yielding carbon dioxide and water.

What actually transpires in the bio-oxidation process? As suggested earlier, there are three types of reactions, all catalyzed by enzymes associated with biologically active slimes and sludges.

First is straight oxidation, which provides the necessary energy for life processes. This can be represented by the equation:

$$C_xH_yO_z + (x + \tfrac{1}{4}y - \tfrac{1}{2}z)O_2 \rightarrow xCO_2 + \tfrac{1}{2}yH_2O + \text{heat} \quad (1)$$

Secondly, additional cells are synthesized, according to an equation like this:

$$n(C_xH_yO_z) + nNH_3 + n(x + \tfrac{1}{4}y - \tfrac{1}{2}z - 5)O_2 \rightarrow (C_5H_7NO_2)_n + n(x-5)CO_2 + \tfrac{1}{2}n(y-4)H_2O \pm \text{heat} \quad (2)$$

Finally, the microbial sludge produced undergoes continuous auto-oxidation (endogenous respiration):

$$(C_5H_7NO_2)_n + 5nO_2 \rightarrow 5nCO_2 + 2nH_2O + nNH_3 + \text{heat} \quad (3)$$

The progress of these reactions is graphically illustrated in the cut on the next page.

The empirical formula $C_5H_7NO_2$ used for cellular material in Eq. (2) was developed by Hoover.[11] This formula is representative of the ratios of the primary element constituents of activated sludge and the statistical average composition of the complex organic compounds constituting cell material.

Studies of various industrial wastes by Helmers et al[7] produced a sludge of 1.02% phosphorus content and 8% nitrogen content, with the general formula $C_{118}H_{170}O_{51}N_{17}P$.

Actually, biological floc is a miscellaneous collection of micro-organisms, such as bacteria, yeasts, molds, algae, protozoa, rotifers, worms and insect larvae, in a gelatinous matrix. The bacterial growths consist of a partially water-soluble polysaccharide slime layer of low structural strength, a cell wall, a lipo-protein cytoplasmic membrane and cytoplasm.

The biological characteristics of a particular sludge will vary with the nature of the wastes being treated. Its flocculation characteristics will depend on the metabolic activity of the system. At a low metabolic activity flocculation occurs rapidly, while at a high metabolic activity there is little or no flocculation.

From the chemical equations the theoretical ultimate oxygen demand of cell material can be calculated as 1.42 g. per g. of cell structure. Actual ultimate oxygen demand is less because of the presence of nonoxidizable matter and because the "volatile solids content" (combustible matter) of some industrial wastes is not all cell material.

Volatile solids content of activated sludges depends on the nature of the waste being treated. A pure microbial sludge will generally run 90-94% volatile. Some industrial wastes are as low as 72%. As the sludge solids are increased in a treatment system, the volatile content will decrease because of the greater endogenous respiration and the increase of inorganic matter in the sludge mass.

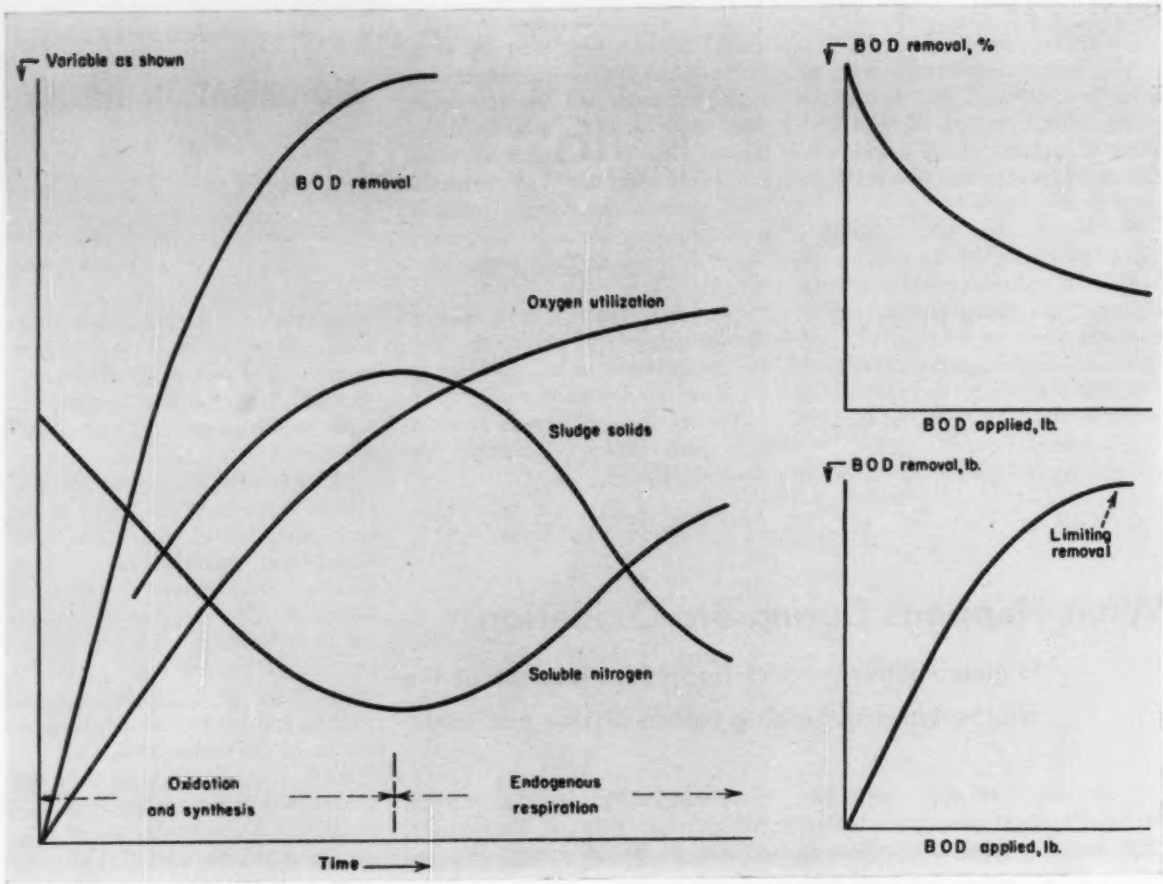
Heat of combustion of activated sludge used in the treatment of milk waste was found to be 10,300 Btu. per lb. of volatile solids.[22] This compares with the value of 10,000 Btu. per lb. of volatile solids reported for domestic sewage activated sludge.[10]

Sludge Growth Phases

In the presence of oxidizable organic matter, bacterial sludge undergoes several growth stages. First is a "lag" (induction) phase. This phase is usually absent in activated sludge and trickling filters because of the large quantity of inoculum employed.

Lag phases may be induced, however, if the sludge is not acclimated to the particular waste being treated. An example of this is the inoculation of an industrial waste with activated sludge from a domestic sewage oxidation. Process lags will also result when sludge in the advanced endogenous phase is recycled for treatment.

Another early phase is the storage of BOD which is removed from solution by the sludge but not immediately metabolized. According to one concept, the organic matter is stored principally as glycogen in the bacterial



REACTIONS occurring during bio-oxidation are shown above.

BOD REMOVAL varies with loading.

cell.[17] As aeration continues and the soluble BOD in the waste is removed by the sludge mass, the micro-organisms consume the stored material for metabolism and growth.

There is evidence that storage is related to the degree of contact during mixing and to the BOD available to be removed. Katz[15] has shown that the initial removal of BOD per unit mass of activated sludge decreases as sludge concentration increases. Further study is needed to establish initial removal ratios for various oxidation systems.

The next phase, the "log growth phase," is defined as that period during which regular and maximum multiplication of sludge cells is taking place. Since sludge growth occurs by the division of one cell into two cells, its rate is a function of the concentration of sludge S present at any particular time, or

$$dS/dt = kS \qquad (4)$$

where k is a growth rate constant.

If generation time g is defined as that interval during which one cell develops and completely divides into two cells, it may be related to k by

$$g = (2.3 \log 2)/k = 0.693/k \qquad (5)$$

The concentration of sludge S at any time t is equal to S_o, the initial concentration, plus ΔS, the increase since t_o, or

$$S = S_0 + \Delta S \qquad (6)$$

Eq. (4) can be integrated by rearranging into the form

$$dS/S = k\,dt \qquad (7)$$

to get

$$\ln (S/S_0) = k\,\Delta t \qquad (8)$$

Combining with Eq. (6),

$$\ln (1 + \Delta S/S_0) = k\,\Delta t \qquad (9)$$

If L_r is the concentration of BOD removed during time Δt and a is the fraction which goes into making new cells,

$$\Delta S = aL_r/1.42 \qquad (10)$$

1.42 is the theoretical factor for converting ultimate BOD to cell material. Combining Eqs. (9) and (10),

$$\ln (1 + aL_r/1.42S_0) = k\,\Delta t \qquad (11)$$

Next is a deceleration phase, in which cellular division occurs at less frequent intervals. It has been shown by several investigators[6, 16] that mean generation time g, and hence k, is dependent on BOD concentration below a limiting substrate level. A mean k, representative of over-all process performance, may be related to microbial food supply.

In the final, endogenous phase of the process there is little or no BOD removal. The sludge concentration is decreasing through endogenous respiration at a greater rate than growth through synthesis.

Designing Bio-Oxidation Plants

Correlations of data from laboratory and plant units are readily translated into equipment specifications.

PROCESSES & EQUIPMENT
BIO-OXIDATION THEORY
PLANT DESIGN

Design of bio-oxidation plants is based on a number of factors, some of which may be determined with the help of laboratory and pilot-plant data, others requiring experience with the operation of full-scale units.

The following discussion is not intended to serve as a complete design manual. However, from it the chemical engineer can gain an appreciation of what goes into plant design and can better collaborate with the biochemist, sanitary engineer and equipment supplier in collecting and interpreting the design data.

BOD Loading Factor

One of the key design factors is the BOD loading factor. This is expressed as lb. BOD per day per lb. sludge content of the liquor in the aeration step.

The table on p. 195 shows data from various waste oxidation systems. In conventional sewage treatment practice 90% BOD removal has been attained with a loading of 0.5 lb. BOD per day per lb. sludge. Increasing this loading to 4.0, while increasing the quantity removed, reduced the percentage removal to 54%. BOD reductions of 80-90% have been attained on cannery and pharmaceutical waste oxidation with loadings of 1 to 2 lb. BOD per day per lb. sludge.

Generalized curves for BOD loading factor vs. removal are shown on p. 198. Data of this type for any particular waste must be obtained by experimental investigations on that waste using well acclimated sludge.

The loading factor employed for process design should consider the total time the sludge mass undergoes aeration in all four phases of sludge activity previously described. Some process modifications, such as contact stabilization, employ a short period for aeration of the waste with the sludge for rapid removal of BOD (principally as storage), followed by a relatively longer aeration of the sludge alone for oxidation and synthesis. The loading factor computed for the waste aeration step alone would be primarily representative of storage only, while the proper loading factor based on the entire sludge mass would consider all process steps.

Interesting studies by McKinney[13] indicate that at high loading factors sludge does not flocculate but functions as a dispersed growth. Only when the sludge approaches the endogenous phase does flocculation occur. Similarly, another study[8] attributes nonflocculant properties (poor settleability) to a young sludge population in the log growth phase.

While there is some doubt as to interpretation of the effects of high loadings on over-all process performance, it is generally conceded that sedimentation and compaction of sludge is impaired when high loading factors are employed.

A similar loading factor may be used for the design of trickling filters. Since exact measurements of the quantity of active sludge in a filter are impractical, the loading factor is usually expressed in terms of BOD per day per cu. yd. of filter medium.

Maximum observed removals in trickling filter operation are 3.1-3.3 lb. BOD per day per cu. yd., with over-all percentage reductions of 25-35%. The quantity of available sludge in a filter has been shown to vary from 8 to 12 lb. per cu. yd. for low-rate filters and 5.5-11 lb. per cu. yd. for high-rate filters.[8] Equivalent maximum removals are 0.2-0.4 lb. BOD per day per lb. sludge. Since the time of contact of BOD through a high-rate trickling filter is 15-25 min., it is probable that the initial reactive capacity of the filter slimes exerts a major influence.

Oxygen Utilization Rate

Another major factor in the design of bio-oxidation units is the oxygen utilization rate, defined as the weight of oxygen consumed by a given weight of microbial sludge per unit of time. It is usually expressed as ppm. per hr.

The rate at which a sludge-liquid mass will take up oxygen depends on the growth phase of the sludge, whether it is undergoing active respiration or endogenous respiration. Rate of oxidation during active respiration is 10 to 20 times the rate of auto-oxidation.

Endogenous respiration rate is frequently expressed as a percent per day of the sludge solids under aeration. This would correspond to a constant rate of oxidation per unit of sludge. Actually the rate decreases with time owing to the fact that the cell constituents differ in ease of oxidation.

When oxygen concentration in the mixed liquor is greater than 0.5 ppm. the rate of bacterial respiration is independent of oxygen concentration. When the oxygen concentration is below 0.2 ppm., the rate of BOD removal is decreased.

A linear relationship exists between sludge concentration and oxygen utilization rate over the range of sludge concentrations usually employed. However, in very high sludge concentrations (10,000 ppm.) the oxygen utilization rate may decrease because of diffusional resistances.

The clumping of sludge cells increases the resistance to mass transfer and thereby lowers the oxygen utilization rate. High degrees of agitation will keep the sludge cells dispersed, decrease the mean floc radius and expose the maximum surface for oxygen transfer, thereby facilitating rapid oxygen utilization.

Chief process variables which affect oxygen utilization rate are temperature, pH and toxic ions. The enzyme systems of biological sludge have an optimum temperature range. Sawyer and Nichols[19,20] found that optimum

respiratory activity occurred at 82 F. Activity at 54 F. was only one-third that at 82, rising with a linear relationship to the optimum, then falling off at higher temperatures.

Bio-oxidation has been observed to occur over the pH range of 4 to 13, with a maximum rate at pH 7.4 in sewage oxidation.[9] Rate of oxygen utilization will fall off rapidly on either side of the optimum value.

Presence of toxic ions in sewage or waste may seriously inhibit the rate of oxygen utilization. The most toxic ions are zinc, copper, chromium, cadmium and nickel.

Nutritional Requirements

Efficient and successful bio-oxidation of organic wastes requires a minimal concentration of nitrogen and phosphorus for the synthesis of new cell tissue. In addition, trace quantities of several other elements, such as potassium and calcium, are required. These trace elements are usually present in natural waters in sufficient concentration to satisfy the requirements for bacterial metabolism. Nitrogen and phosphorus, however, are frequently deficient in waste substrates and must be added to the system in some suitable form to attain optimum operation.

Because many activated sludges contain an appreciable inert and amorphous fraction, the critical nitrogen content may be quite low. For example, a biological sludge from a pulp and paper waste containing a large percentage of stable organic matter had a critical nitrogen content of 3.5% based on total volatile solids. By comparison, the nitrogen content of an average domestic sewage biological sludge is 7.5%.

Nutritional requirements may be expressed as a fraction of the total volatile solids, as lb. N or P per 100 lb. BOD removed, or as BOD/N and BOD/P ratios. Nitrogen and phosphorus requirements may be rigorously computed from a material balance based on the maintenance of minimum nitrogen and phosphorus contents in the biological sludge.

When nutritional supplements are required, ammonia nitrogen and soluble phosphorus salts are generally used, since they are most readily assimilable. It is usually not advisable to add nitrates because they serve as a secondary source of oxygen for the organisms. In secondary settling tanks where the available oxygen may be depleted, nitrates are reduced and nitrogen gas is formed, resulting in a floating sludge.

Selection of a feed system for any given installation should be determined by a comparative cost study, considering economy, transportation, handling problems and reliability of supply. Table[14] shows the relative costs of nutrient chemicals for a pulp and paper waste treatment plant, based on 100 for the least costly. (In the case of ammonium phosphates, costs allow credit for the nitrogen content.)

Relative costs of Nutrient Materials

Nitrogen	
Anhydrous ammonia (c.l.)	100
30% aqueous ammonia (c.l.)	107
Ammonium sulfate, bulk (c.l.)	170
Ammonium sulfate, bagged (l.c.l.)	250
Anhydrous ammonia, 150-lb. cylinders	300

Phosphorus	
75% phosphoric acid, bulk (c.l.)	100
75% phosphoric acid, drums (l.c.l.)	133
Monoammonium phosphate (l.c.l.)	126
Diammonium phosphate (l.c.l.)	133
Monosodium phosphate (l.c.l.)	165
Trisodium phosphate (l.c.l.)	256

Sedimentation and Flotation

Sludge-liquid separation is an integral part of bio-oxidation plants. Design of equipment is complicated by the fact that changes in process variables such as loading, temperature and pH can change the physical character of the sludge solids. But proper design is essential, since the concentration of active sludge solids which can be maintained in the aeration basins is limited by the settling and compaction characteristics of the sludge in the secondary settling tanks.

Among process factors to be considered in clarifier design are the rate and nature of biological action in the anaerobic environment of the clarifier and rate of sludge settling and compaction. These factors are intimately related to the chemical nature of the waste being treated and to the loading characteristics of the sludge system.

For example, an activated sludge from a food processing waste could not be held in a final tank for long periods because of its high activity and gas production. As a result, maximum sludge concentration attainable in the final settler was only 0.4-0.7%. By comparison, a low-activity sludge from a pulp and paper waste could be maintained for extended periods in the final settling tank. Concentrations as high as 3.0% could be attained.

Proper control of sludge environment helps get optimum settleability. Decreased settleability has been attributed to insufficient air, excessive filamentous growths, excessive carbohydrates and other causes. Specific gravity of the bacterial mass, which has been reported to vary from 1.02 to 1.12, can be directly related to the growth cycle of the organisms and, thus, to the available food.

In industrial systems which support several species of micro-organisms, the conditions established in the process will tend to repress or stimulate the growth of particular species. For example, in treating pulp and paper wastes by activated sludge, maintenance of fully aerobic conditions stimulated the growth of filamentous forms of low settling rate. When this sludge was allowed to settle in a clarifier under anaerobic conditions for several hours, these forms were suppressed, and the sludge settling rates increased.

Two general types of units, circular and rectangular, may be used for final clarification. Selection and design demand special considerations.

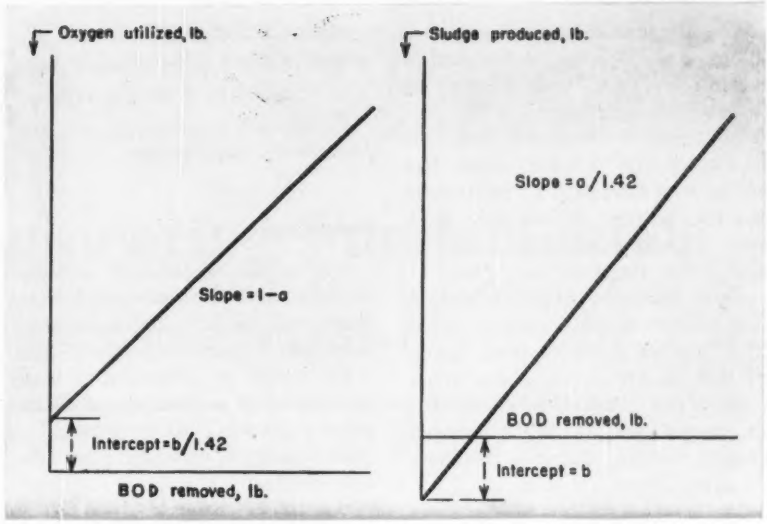
On entering the clarifier, the sludge falls almost vertically to the bottom, where it encounters previously accumulated sludge and creates turbulence. The sludge then flows along the bottom toward the outlet, establishing eddy currents in the reverse direction in the water layers above the sludge level.

In long rectangular clarifiers the turbulence may be high enough to cause bottom scour and solids carryover. This problem is minimized in circular clarifiers, since the turbulence is dissipated rapidly as the liquor approaches the periphery of the tank.

Consideration also must be given the time required to get the sludge discharged from the tank in order to avoid excessive decomposition. Conventional sludge-removal mechanisms in rectangular clarifiers move the settled sludge along the bottom at a velocity of about 1 ft. per min.

Two major types of sludge-collecting mechanisms used in circular tanks are the center drawoff and the vacuum sweeper. Center drawoff may employ a plow or a rotary hoe mechanism. Each plow moves the sludge inward about 6 ft. per revolution. The vacuum sweeper offers the advantage of continuous sludge removal over the entire area of the tank bottom.

One way to get around the limitations of sludge settling and compaction characteristics is to use flotation, instead of sedimentation, for sludge-liquid separation. Experimental studies on activated sludges of various wastes showed that flotation can produce a concentrate of 2 to 3% solids.



EXPERIMENTAL data plotted thus is basis for plant design.

Experimental Data

As in many chemical plant design problems, application of theoretical principles to design of bio-oxidation plants requires that certain essential data be obtained experimentally.

Laboratory studies in 5-liter fermentors or similar apparatus will yield fundamental data relating oxygen utilization and sludge production characteristics, BOD removal rate data and nutritional requirements. BOD loading and mixed liquor concentrations should be representative of anticipated process conditions.

Acclimatized sludge should be used in all experimental studies. This may be accomplished by systematically feeding a domestic sewage sludge with the waste to be studied for several days prior to making the experimental observations.

Data taken during such a study should include oxygen utilization rate, solids balance, nitrogen and phosphorus in the sludge, soluble nitrogen and phosphorus in the process liquor and soluble BOD remaining. Data taken over selected time intervals up to 24 hr. will usually be sufficient for computing the necessary empirical constants and obtaining typical plots of BOD loading vs. removal.

Experimental data from batch studies may not exactly describe continuous process operation because of variations in sludge quality and other factors. If more exact data are needed, a pilot-plant study should be made. Use of laboratory data for pilot-plant design can save considerable time in this phase of the study. Experience has shown that waste flows of 5 to 20 gpm. through a pilot plant can be directly translated to ultimate plant design.

Illustrative Problem

Here is an illustrative example of the application of these principles to process design of a bio-oxidation plant.

Quantity of waste liquor is 0.94 million gal. per day with an ultimate BOD content of 980 ppm. and available nitrogen content of 5.0 ppm. Flow and BOD are assumed constant. Required removal efficiency is 90%.

BOD loading is computed as

$$(0.94)(8.33)(980) = 7{,}650 \text{ lb. per day}$$

and BOD removal is

$$(7{,}650)(0.90) = 6{,}900 \text{ lb. per day}$$

Other conditions determined from experimental studies are: Suspended solids concentration in mixed liquor = 2,500 ppm.; volatile suspended solids in mixed liquor = 2,100 ppm.; solids concentration in return sludge = 8,000 ppm.; average endogenous respiration rate = 8% per day.

Ratio of recycle flow to feed is

$$2{,}500/(8{,}000 - 2{,}500) = 0.45$$

and recycle flow is

$$(0.94)(0.45) = 0.42 \text{ mgd.}$$

The computed recycle ratio assumes no solids in the raw waste and the build-up of active solids through the aeration system is omitted in the calculation.

Aeration Tanks—From an experimentally determined plot of BOD loading vs. removal, the allowable loading for 90% removal is found to be 1.0 lb. BOD per day per lb. sludge. In other words, the aeration tank must contain 7,650 lb. of sludge.

Sludge solids are recycled to the aeration tank at a rate of

$$(0.42)(8.33)(8{,}000) = 28{,}000 \text{ lb. per day}$$

so that the required amount of sludge is equivalent to a hold-up of

$$(7.650)(24)/28{,}000 = 6.5 \text{ hr.}$$

Tank volume is simply

$$(0.94 + 0.42)(6.5)/24 = 0.37 \text{ million gal.}$$

For computing the volumes of aeration tanks when the biosorption process is used, the volume of the contact stabilization tank is deducted from the required total volume.

Air Requirements—Oxygen consumption can be estimated separately for the oxidation of BOD and for the oxidation of sludge.

The first is concerned with the fraction of BOD removed which does not go into formation of new sludge but goes directly to oxidation products. According to the previous definition of a, this fraction is $(1 - a)$.

From laboratory studies a relationship between oxygen consumption and BOD removal can be derived, similar to that shown in the above graph. Slope of the line $= (1 - a) = 0.325$ lb. oxygen per lb. BOD removed. Oxygen for this process is therefore

$$(0.325)(6{,}900) = 2{,}250 \text{ lb. per day}$$

Since endogenous respiration rate is 8% per day of the sludge undergoing aeration, the sludge oxidized is

$$(0.08)(0.37)(8.33)(2{,}100) = 518 \text{ lb. per day}$$

This will require

$$(518)(1.42) = 735 \text{ lb. oxygen per day}$$

so total oxygen required is

$$2{,}250 + 735 = 2{,}985 \text{ lb. per day}$$

Required utilization rate is simply

$$2{,}985/(0.37)(8.33)(24) = 40 \text{ ppm. per hr.}$$

Selection of aeration equipment will take into account the required oxygen utilization rate.

Sludge Production—Fraction of BOD removed which goes into sludge formation is $a = 0.675$. Gross sludge produced is therefore

$$(0.675)(6{,}900)/1.42 = 3{,}290 \text{ lb. per day}$$

This figure is reduced by the amount of sludge oxidized, as computed above, to get net sludge production

$$3{,}290 - 518 = 2{,}772 \text{ lb. per day}$$

This relationship can be obtained experimentally as shown in the graph.

Sludge production just computed is actually the active, or "volatile" sludge. Since volatile suspended solids $= 2{,}100/2{,}500$ or 84% of the total suspended solids, actual total sludge leaving the process, including inerts, is

$$2{,}772/0.84 = 3{,}300 \text{ lb. per day}$$

Nutritional Requirements—From experimental studies critical nitrogen content = 7% of the net biological solids. Total nitrogen required is

$$(0.07)(2{,}772) = 194 \text{ lb. per day}$$

Nitrogen available in waste is 5.0 ppm., or

$$(0.94)(8.33)(5.0) = 39 \text{ lb. per day}$$

so that nitrogen to be supplied is

$$194 - 39 = 155 \text{ lb. per day}$$

Phosphorus requirements are computed in the same manner.

Plant Costs

Application of modern concepts of biological waste treatment has not progressed sufficiently to provide much more than a smattering of cost data.

Plant costs are dependent on many variables, such as volume and characteristics of waste to be treated, required quality of treatment plant effluent, method of disposal of waste sludge and selection of type of treatment process. Regulations may vary; for example, some regulatory groups may require holding reservoirs ahead of or below the treatment plant as an assurance that a stream will not be polluted during a possible failure of the treatment facilities. Other major factors are the maximum amount of in-plant reclamation and the specific hydrographic and topographic conditions.

Though two process plants may be quite similar, their costs for waste treatment may be of different magnitudes. In addition to the variables mentioned above, frequently it is more economical to use separate small treating units designed for individual process wastes within one industrial plant. Some locations permit gravity flow through the treatment plant, eliminating the cost of pumping. Materials of construction suitable for one plant may be unsuited for another.

Finally, treatment plant costs are greatly affected by use of existing equipment, by degree of automation, by differences in design philosophy and engineering standards.

Nevertheless, for what they are worth, here are a few examples of approximate costs for construction and operation of bio-oxidation plants:

1. A gravity-flow, high-rate activated sludge plant treating 30,000 gal. per day of packinghouse waste with an average BOD of 1,600 ppm. was constructed for about $30,000. This cost included $15,000 equipment.

2. A 16-20 mgd. activated sludge plant treating pulp and paper wastes having an average BOD of 200 ppm. cost about $75,000 per mgd. Operating cost was approximately $23 per million gal. treated.

3. A starch processing plant with a waste flow of 0.45 mgd. and a BOD of 2,200 ppm., using submerged-culture aeration, cost $172,000 per mgd., with an operating cost of approximately $85 per million gal.

4. A 1951 survey of several activated sludge plants treating domestic wastes with an average BOD of 200 ppm. and a range of flow from 1.75 to 102 mgd. showed an operating cost of approximately $29 per 1,000 lb. BOD removed.

5. Two-stage trickling filter plants with digesters, treating high-BOD wastes from turnpike establishments with flows averaging 50,000 gal. per day, cost $74,000 per plant.

6. A 5.0-mgd. single-stage trickling filter plant treating domestic wastes in Florida cost (in 1950) $126,000 per mgd.

In general, the capital cost of activated sludge plants is less than trickling filter plants for the same service, while operating costs for trickling filter treatment is somewhat less than activated sludge. The margins of difference depend on size of plant and degree of treatment.

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CE REFRESHER

Chemical Engineering Fundamentals

General Considerations in Reactor Design—I

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Process design is one of the most important professional tools of the chemical engineer. Ability to apply chemical and physical principles along with common sense and the rule-of-thumb "know-how" to come up with a practical plant design are the features that make the chemical engineer valuable to industry.

In applying the fundamental principles of chemistry and physics to the design of chemical plants, the problem generally resolves itself into two broad categories:

- Process design.
- Mechanical design.

The line between these two areas is not at all clear cut and there is much overlapping.

Process design is generally concerned with the requirements of the process itself. This includes the problems of reacting chemicals, heating or cooling materials, distilling, crystallizing, purifying, transporting the materials, etc.

Mechanical design is usually concerned with the structural features of each piece of equipment including shell thickness, strength of supporting members, buildings, foundations, support structures, and provisions for installation and maintenance of all equipment.

Chemical engineering design usually refers to the process part of the problem. How far the chemical engineer should intrude into mechanical problems has never been clearly defined and probably will always vary for different processes.

From this point on we will limit our discussion to process design. We don't mean to infer that mechanical design is not as important as process design. Mechanical design is equally important and in many cases the mechanical features may make or break a process. However, it is in the process design part of the problem that kinetics can be applied.

Major Parts of a Process

Most chemical processes can be broken down into these broad steps:

- Purify the reactants.
- React them.
- Separate the products.
- Purify the products.

All of these steps, except that of reaction, generally involve well-known unit operations such as heat transfer, distillation, crystallization, drying, extraction, absorption, adsorption, etc.

The reaction step involves the important factors of chemical reaction, mixing, diffusion and heat transfer in a much more complicated interrelationship than in the case of the purely physical unit operations.

In the organic chemical industry the design of a process often involves only the problems of chemical reaction, heat transfer, distillation, liquid transportation and storage. Here the process design may consist of only the following steps:

- Design the reactor.
- Size the distillation columns.
- Size the heat exchangers.
- Select the control instruments.
- Size the pumps.
- Lay out the equipment.
- Size the storage facilities and piping.

The process design engineer faces an entirely different problem in the chemical reactor design than he does in any of the rest of the steps listed above.

The difference is this. There are established procedures for designing a distillation column for a given separation if the physical properties (vapor pressure, activity coefficient, viscosities, densities, etc.) are known. You usually don't have to run the distillation in a pilot plant before you design the column.

The same is true in the case of heat exchangers; they don't have to be tried out in the laboratory or pilot plant first. Pumps, evaporators, storage tanks, instruments (conventional ones, that is) and similar equipment are in the same category.

Therefore, much of the problem of process development is the problem of reactor design. There are no cut and dried methods for designing chemical reactors from general chemical and physical data. There must be specific information on the reaction being considered. Information on the rate of reaction or on product distribution may be obtained on a laboratory scale, bench scale, or in a pilot plant.

However, the information must be specific to the reaction in question.

How Can Kinetics Help?

There are two conditions which must be met in obtaining experimental data for reactor design. Either the data obtained on a small scale must be at exactly the same physical conditions as those proposed for the commercial-scale reactor, or else there must be some way of extrapolating the reaction data from the experimental conditions to the conditions to be used in the large-scale reactor.

In many cases the first condition is impossible because of heat losses, product mixing, diffusion effects and other characteristics of a large reactor which cannot be duplicated on a small scale. The use of kinetics—as well as thermodynamics—may be a valuable tool in making the second condition possible.

Kinetics can often be used to predict reactor size and product distribution from laboratory data or to predict the effect of a major change in process variables such as reactant ratio or product recycle. Kinetics can often be used to predict the effect of a major change in reactor type, such as changing over from a stirred tank to a continuous coil reactor. Also, kinetics can be used to predict the effect of more heat transfer surface or more insulation on reactors. Kinetics can be used to predict almost anything!

In order to make better use of kinetics in predicting the effect of changes of process variables and to design reactors, the chemical process engineer should have a clear understanding of the types of reactors and of the types of reaction systems that are encountered.

He should also understand in a qualitative manner, at least, how the process variables affect each type of reaction in all kinds of reactors. The use of kinetics will promote this understanding.

We will devote the remainder of this CE Refresher section to a discussion of the types of reactions, types of reactors and the effects of the major process variables on each combination of reactor and reaction system.

How to Classify Chemical Reactors

1. Simple batch homogeneous reactors
- Closed tank
- Rocking autoclave (laboratory tool, not used commercially)
- Stirred kettle
- Kettle with outside recirculation but with no material added or removed
- Coil with outside recirculation but with no material added or removed

2. Semi-batch reactors
- Batch with continuous addition of one reactant
  - Gas phase addition
  - Liquid addition
  - Solid addition
- Batch with continuous removal of one product
  - Gas formation
  - Solid precipitation
  - Formation of immiscible liquid
- Batch with combined addition of reactant and removal of one product

3. Continuous homogeneous reactors
- Longitudinal tubular reactor (no backmixing)
- Stirred tank reactor (complete backmixing)
- Tubular reactor with some backmixing
- Tower reactors
  - Packed tower
  - Empty tower
  - Baffled reactor
- Baffled tank reactor
- Longitudinal reactor with multiple injection of one reactant

4. Continuous heterogeneous reactors
- Packed tower countercurrent reactors
- Fixed-bed catalytic reactors
  - Longitudinal
  - Backmixing
- Moving- and fluidized-bed catalytic reactors
  - Longitudinal
  - Backmixing
- Distillation column

Factors in Selecting and Sizing Reactors

When a process engineer is faced with the problem of designing the commercial or semicommercial unit he must first choose the reactor to be used. If the reaction is liquid phase, should the reactor be a tank with an agitator? Should it be a long tube or coil? Should it be a packed tower? An empty tower? A horizontal baffled tank?

For some reactions, it doesn't make any difference; for others it does. Should the reactor be operated at a nearly uniform temperature with adequate heat removal or adiabatic? Or neither? Or does it make any difference? Should some product be recycled? Should a large excess of one reactant be used? When are these factors important?

The type of reactor (tube or tower or tank), the type of operation (batch, continuous, recycle or no recycle) and the means of temperature control (isothermal or adiabatic) may depend on the type of reaction involved.

If the reaction is vapor phase over a catalyst, should a fixed, moving or fluidized bed be used? Should the engineer use a short thick reactor or a long tubular one? These factors may also be affected by the type of reaction.

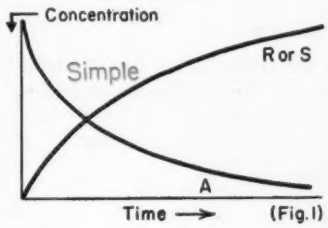
These are some of the problems in selecting and sizing a reactor. In order to choose the best reactor and method of operation, the specific type of reacting system must be considered.

Reaction Systems

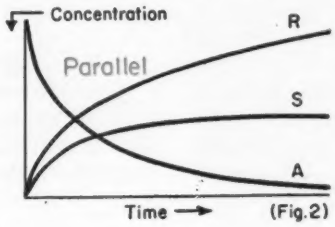
Reaction systems can be divided into the following groupings:

- Homogeneous liquid phase, only liquids involved and all mutually soluble.
- Heterogeneous liquid phase, involves two or more immiscible liquids.
- Reaction of a liquid with a gas.
- Reaction of a liquid with a solid.
- Liquid phase reaction forming a solid.
- Liquid phase reaction forming a gas.
- Homogeneous gas phase reaction.
- Heterogeneous gas phase catalytic reaction.

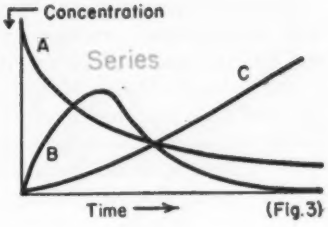
Concentration–Time Curves Help Classify Chemical Reactions



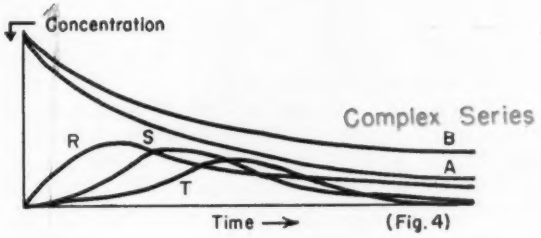
(Fig. 1)



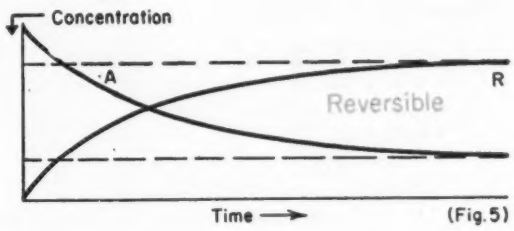
(Fig. 2)



(Fig. 3)



(Fig. 4)



(Fig. 5)

• Heterogeneous gas phase noncatalytic reaction. These are the common reaction systems, but other combinations can be named.

Chemical Reactors

Most of the reaction systems listed above can be set up in any of a number of reactors. The most common types of chemical reactors can be classified according to the scheme shown in the table on p. 204.

We want to describe each of these reactors briefly. In some cases the actual physical piece of equipment may be the same and the difference in classification may be due to a change in the method of operating the equipment. This is the case, for example, with batch, semi-batch and stirred continuous reactors.

Simple Batch Homogeneous Reactor—The simple batch continuous reactor is the most common type of reactor. From this kind of reactor, many kinetic data have been obtained. All of the reactants are charged in at the beginning of the reaction. Then the reactor is sealed and there is no mass transfer into or out of the reactor until the reaction is complete. The reactor may or may not be agitated. The batch reactor is represented by the chemist's flask, the rocking-bomb autoclave, the stirred tank, the kettle with outside recirculation and the continuous recirculating coil.

Semi-Batch Reactors—The batch reactor with continuous addition of one reactant is one in which one or more of the reactants is charged at the beginning of the reaction and one reactant is continually added as the reaction proceeds. The added reactant may be a liquid, a gas or a solid.

Another classification of a semi-batch reactor also has wide commercial application. This is one in which a gas forms or a solid precipitates during the reaction. Here also, a volatile product may be fractionated off continuously. An example: batch esterification with continuous distillation.

These two classes of semi-batch reactors may be combined. One example is in the wet process of acetylene manufacture. Here solid calcium carbide is dropped into water, acetylene gas evolves and lime precipitates.

Continuous Homogeneous Reactors—Of the longitudinal tubular reactors, the most common type is the single-pass long tube such as those in thermal cracking furnaces. There is another type which is essentially just a number of single tubes in parallel. In both cases the ratio of length to diameter of the tube is large. In this reactor we assume that the reacting system travels through the reactor in "plug flow" with no backmixing in the direction of travel. The tubular continuous reactor is also known as the longitudinal reactor.

In the stirred-tank continuous reactor, reactants are fed continuously and products are withdrawn continuously. The reactor consists of a tank or kettle with an agitator. Contents are completely mixed at all times. This represents the extreme case of a backmixing reactor. Backmixing is 100%.

In a tubular reactor, if the ratio of length to diameter is not large enough, there will be some backmixing and the reactor will deviate from the hypothetical plug flow. In actual practice all tubular reactors deviate from plug flow because of velocity gradients in the transverse direction. This is more the case with empty tubes than with packed ones.

Tower reactors may consist of an empty tower, a packed tower or a baffled tower. Where a large volume is needed this type of reactor is less expensive than a tubular reactor. However, the amount of backmixing is much greater.

The baffled tank reactor is usually a horizontal tank with a low ratio of length to diameter. It has about the same advantages and disadvantages as the tower reactor.

The longitudinal reactor with multiple injection of

one reactant is a special case and corresponds somewhat to the semi-batch reactor.

Continuous Heterogeneous Reactors—The most common heterogeneous reactors are the fixed-, moving- and fluidized-bed catalytic reactors. These can be designed as longitudinal or backmixing reactors. In actual practice, most fixed-bed reactors are longitudinal consisting of many reactor tubes in parallel. Most fluidized-bed reactors are of the backmixing type. Moving-bed reactors can be designed for either kind of operation.

Method of Operation

In addition to types of reaction systems and types of reactors, there are three general methods of operation for chemical reactors. They are:

- Isothermal.
- Adiabatic.
- Nonisothermal, nonadiabatic.

In the isothermal case just enough heat is added (endothermic reaction) or removed (exothermic reaction) to keep the temperature constant throughout. This can be done in actual practice by providing a large heat reservoir such as boiling Dowtherm or molten salt or molten metal. This reactor is the easiest for calculating but is the least used.

No heat is added to or removed from the adiabatic reactor and the temperature of the reacting system is determined by the heat of reaction. It's more difficult to calculate with this reactor but it is used more often.

In the nonisothermal nonadiabatic reactor some heat is added or removed but the temperature does not remain constant during the reaction. This is the most difficult type of reactor to calculate; but almost all commercial reactors are in this class.

The Type of Reaction

One of the most important factors in the selection of a reactor is the kind of reaction that is involved.

Reactions may be classified into five main groups:

- Simple reactions.
- Parallel reactions.
- Series reactions.
- Complex series reactions.
- Reversible reactions.

Let's look briefly at each of these groups.

Simple reactions are those such as

$$A + B \xrightarrow{k_1} R + S$$

Only one reaction takes place in the system. Fig. 1 shows a typical concentration-time curve for this reaction.

Parallel reactions involve reactants in competing reactions such as

$$A \xrightarrow{k_1} R$$
$$A \xrightarrow{k_2} S$$

or

$$A + B \longrightarrow R + S$$
$$A + C \longrightarrow V$$

Fig. 2 shows a concentration-time for parallel reactions.

Series reactions are of the type

$$A \xrightarrow{k_1} R \xrightarrow{k_2} S$$

Fig. 3 shows a time-concentration curve for this type.

Complex series reactions are reactions where one reactant reacts with the product so that both series and parallel reactions take place simultaneously. An example of this is

$$A + B \longrightarrow R$$
$$A + R \longrightarrow S$$
$$A + S \longrightarrow T$$

This is a series reaction with respect to B, R and S but a parallel reaction with respect to A. A concentration-time curve is shown in Fig. 4.

Reversible reactions are those which do not go all the way to completion before equilibrium is reached. Any of the reactions described above could also be reversible. We shall see later that some calculation methods that apply to nonreversible reactions can not be used for reversible reactions.

We Pause to Take Stock

This installment was meant to give a quick view of the factors involved in the process design of chemical reactors. We see that the design of a chemical plant can be roughly divided into process design and mechanical design. The process design of a new process can be further subdivided into two major problems: the design of the reactor; and the design of the rest of the process.

Selection and design of a reactor is a unique problem for each process and usually can not be solved by a systematized general approach such as that used in distillation columns or heat exchangers.

There are four important interacting factors which must be considered for the proper selection and sizing of the reactor. These are: reacting system; type of reactor; method of operation; and the type of reaction.

In the next two installments we will discuss the interaction of these four factors and the effects of changing process variables on the various types of reactions and reactors.

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which of these do you handle?

ACIDS (INORGANIC & ORGANIC)	Recommended HR = Hard Rubber SR = Soft Rubber	Maximum Temperature, deg. C.
Acetic	HR	70
Acetic Anhydride	HR	70
Arsenic	HR-SR	70
Boric	HR-SR	70
Citric	SR	40
Formic	HR	70
Hydrobromic	HR-SR	70
Hydrochloric	HR-SR	70
Hydrofluoric (up to 50%)	HR-SR	70
Hydrofluosilicic	HR-SR	70
Hydrogen sulphide water	HR	70
Lactic	HR	Room Temp.
Nitric (up to 20%)	HR	70
Oleic	HR	70
Oxalic	HR-SR	70
Phosphoric (up to 85%)	HR-SR	70
Salicylic	HR	70
Stearic	HR	70
Sulphuric (up to 50%)	HR-SR	70
Sulphurous	HR	70
Tartaric	HR-SR	70
Tannic	HR-SR	

SOLUTIONS OF INORGANIC SALTS AND ALKALIES	Recommended HR = Hard Rubber SR = Soft Rubber	Maximum Temperature, deg. C.
Sodium (or potassium) hydroxide	HR-SR	70
Sodium (or calcium) hypochlorite	HR-SR	70
Sodium sulphate	HR-SR	70
Sodium (or potassium) sulphide	HR-SR	70
Sodium (or potassium) sulphite	HR-SR	70
Sodium thiosulphate	HR-SR	70
Stannic chloride	HR-SR	70
Stannous chloride	HR	70
Sulphite Liquors	HR-SR	70
Zinc chloride	HR-SR	
Zinc sulphate		
HALOGENS		
Chlorine (dry) at low pressures	HR-SR	70
Chlorine water (hypochlorous acid)	HR-SR	70

SOLUTIONS OF INORGANIC SALTS AND ALKALIES		
Aluminum chloride	HR-SR	70
Aluminum sulphate	HR-SR	70
Alums	HR-SR	40
Ammonium hydroxide	HR	70
Ammonium sulphate	HR-SR	70
Barium chloride	HR-SR	70
Brine (acid)	HR	70
Calcium bisulphite	HR-SR	70
Calcium chloride	HR-SR	70
Calcium hydroxide	HR-SR	70
Cupric sulphate	HR	70
Cupric chloride	HR-SR	70
Ferric chloride	HR-SR	70
Ferric sulphate	HR-SR	70
Ferrous chloride	HR-SR	70
Ferrous sulphate	HR-SR	70
Magnesium chloride	HR-SR	70
Mercuric chloride	HR-SR	
Plating solutions: Brass, Cadmium, Copper, Gold, Lead, Nickel, Silver, Tin, Zinc	HR-SR	70
	HR	70
Potassium Dichromate		70
Sodium (or potassium) bisulphate	HR-SR	70
Sodium (or potassium) bisulphite	HR	70
Sodium cyanide	HR-SR	

ORGANIC MATERIALS		
Acetaldehyde	HR-SR	70
Acetic anhydride	HR	70
Acetone	HR-SR	70
Alcohols	HR-SR	70
Ammonium Thioglycolate	HR	70
Amyl, butyl, ethyl acetates	HR-SR	70
Aniline hydrochloride	HR-SR	70
Casein	HR	70
Castor Oil	HR	70
Cocoanut Oil	HR	70
Cottonseed Oil	HR	70
Dyestuffs	HR-SR	70
Ethers	HR-SR	40
Ethylene glycol	HR	40
Formaldehyde (up to 40%)	HR	70
Furfural	HR-SR	70
Fruit juices	HR-SR	70
Glucose	HR-SR	70
Glycerine	HR-SR	70
Ketones	HR	40
Milk	HR	70
Mineral Oils	HR	70
Olive Oil	HR	70
Soaps	HR-SR	70
Triethanolamine	HR	
Vinegar		

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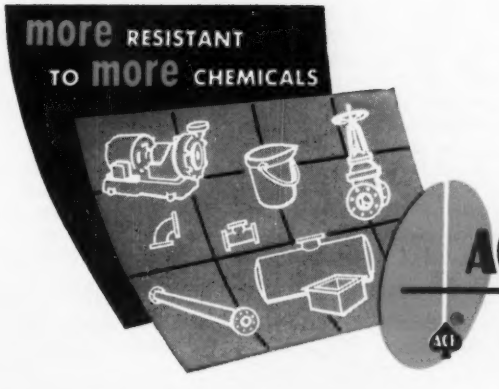

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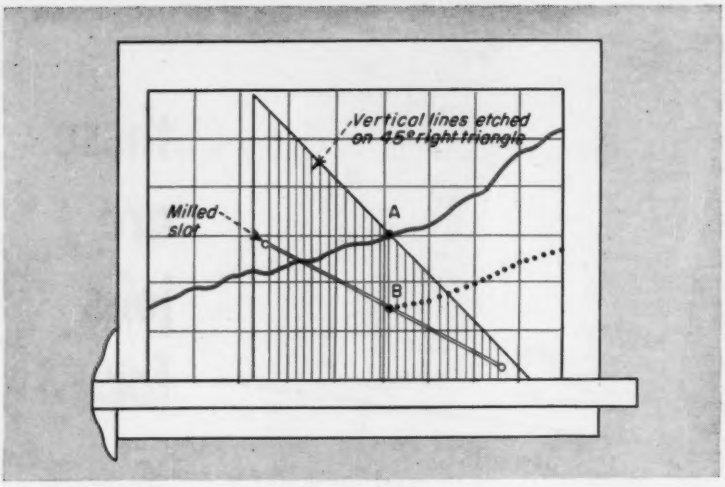

★Winner of June Contest

Triangles Aid Replotting of Curves

H. J. Ramey, Jr.

Field Research Labs., Magnolia Petroleum Co., Dallas, Tex.

The sketch above shows a simple method for reducing or expanding one scale of a curve plotted upon Cartesian coordinates. It often happens that process operating curves and other plotted data are unsuited to formal presentation (publication, reports, lantern slides, and the like), because in the original draft one coordinate scale was compressed or magnified too much. Photographic reproduction is useless for this problem, since both scales are changed by the same factor. It therefore comes down to replotting, which can be accomplished in many ways (e.g., by proportional dividers), most of which are likely to be tedious or inaccurate, or both.

I have found the method described here to be an easy and accurate way to replot such curves to a more suitable scale. The tools—a set of right triangles made from ⅛-in. acrylic plastic—can also be used for normal drafting purposes and so easily justify the work required in making them. The triangles used were all of the 8-in., 45° size, but any size or type could be used. In each triangle a slot the width of a pencil point was milled along a line from the vertex of one of the 45° angles. The line was constructed to divide the side opposite the angle by a desired factor, such as two, three, etc. Then evenly spaced lines were etched perpendicular to the base side of the triangles.

The sketch shows how such a triangle is used. The triangle illustrated (which divides the vertical side by two) can be used to halve or double the variable plotted along the ordinate. First, place a sheet of tracing paper, or tracing graph paper, over the curve to be modified. Then lay a straightedge along the base line of the abscissa. Place the triangle on the straightedge and locate the intersection of the curve and the hypotenuse of the triangle at Point A.

Now follow the vertical etched lines downward and plot a point at the intersection of the milled slot and the proper vertical line, at Point B. Other points are similarly plotted until the reduced curve is complete.

The same triangle may be used to double the ordinate scale by locating points on the original curve in the milled slot, and plotting the corresponding points along the hypotenuse. Since the process may be repeated n times with the same triangle, it can be used to achieve a magnification or reduction of $(2)^n$ or $(\frac{1}{2})^n$.

★Winner of July Contest:

Simple Controls Can Change Your Batch Still From Manual to Automatic Operation.

As winner of the July Plant Notebook Contest, this article has earned a prize of $50 in cash for D. E. Mack, of Imperial Paper & Color Corp.'s research department, at Glens Falls, N. Y. The batch still, formerly manually controlled, was put on automatic reflux control for an additional expenditure of only $235.

$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for the Plant Notebook.

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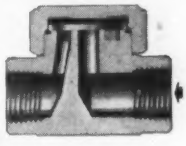

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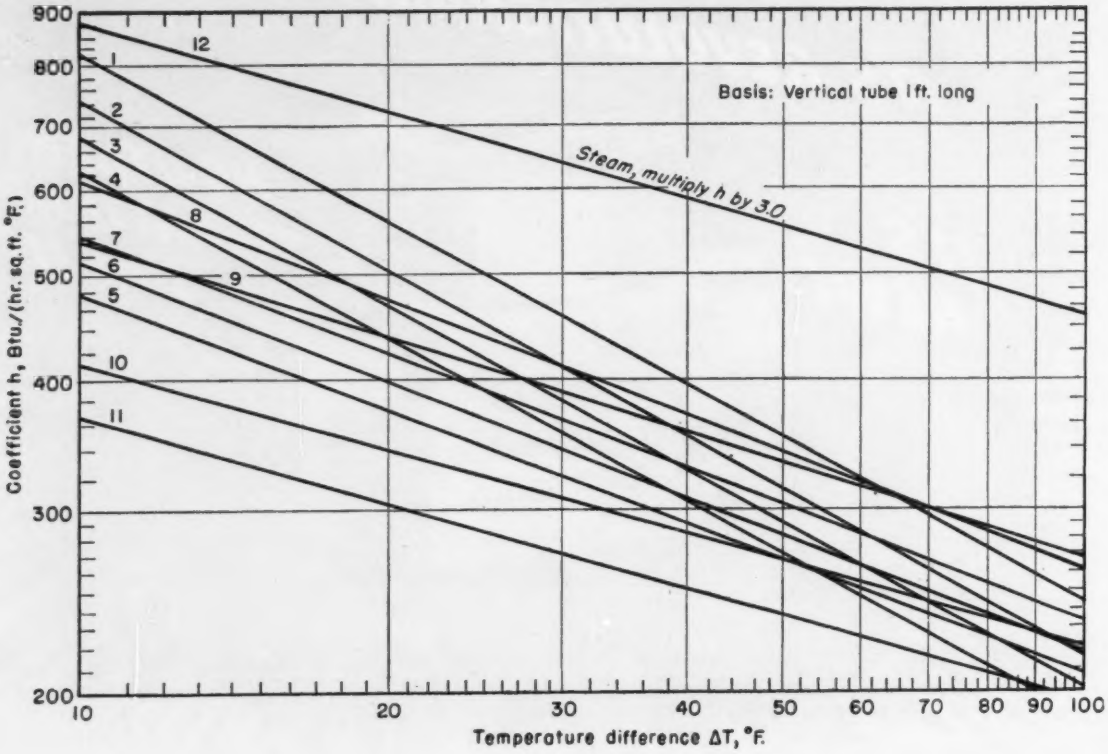

Condensation Film Coefficients Plotted

D. Venkateswarlu

Department of Chemical Engineering, Indian Institute of Technology, Kharagpur, India.

Nusselt's theoretical relations for the film coefficients encountered in condensing vapors on vertical and horizontal tubes have been given by such writers as McAdams[3] and Kern[2], along with the assumptions involved in deriving them. For vertical tubes:

$$h_m = 0.943 \left(\frac{k_f^3 \rho_f^2 \lambda g}{\mu_f L \Delta t} \right)^{0.25} \quad (1)$$

For horizontal tubes:

$$h_m = 0.725 \left(\frac{k_f^3 \rho_f^2 \lambda g}{\mu_f N D \Delta t} \right)^{0.25} \quad (2)$$

Film coefficients are normally calculated from these equations, or their modifications, or taken from alignment charts such as those of Chilton, Colburn, Genereaux and Vernon[1] which are based on these equations. However, the observed film coefficients summarized by McAdams[3], as well as subsequent experimental data reported by several investigators, have shown considerable deviations from the theoretically predicted values. In some cases these have been as high as 50-70%.

On this account, experimental film coefficients are preferred to the theoretical values for process equipment design calculations. Experimental film coefficients reported in the literature are generally of length or diameter different from those of the proposed condenser design, but they can be used for process design if reduced to a common basis as described below for vertical tubes.

Equation (1) for vertical tubes can be simplified if part of the expression $0.943\ (k_f^3 \rho_f^2 \lambda g/\mu_f)^{0.25}$ is taken as K, a constant for a vapor at a given Δt. Then $h_m = K\ (1/L\Delta t)^{0.25}$. If this simplified equation

Identification of Curves on Graph

1	Methyl alcohol	7	Propyl acetate
2	Propyl alcohol	8	Butyl acetate
3	Butyl alcohol	9	Acetone
4	Amyl alcohol	10	Benzene
5	Methyl acetate	11	Chlorobenzene
6	Ethyl acetate	12	Steam (mult. × 3)

Nomenclature

- D Diameter of tubes, ft.
- D' Diameter of tubes, in.
- g Acceleration of gravity, ft./sec.^{2}
- h_m Mean condensation film coefficient, Btu./ (hr. sq. ft. °F.)
- K Constant
- k_f Thermal conductivity of condensate at film temperature, Btu./ (hr. sq. ft. °F. per ft.)
- N Number of horizontal tubes in a vertical row.
- L Tube length, ft.
- Δt Temperature difference, °F.
- λ Latent heat of condensation, Btu./ lb.
- μ_f Absolute viscosity of condensate film at film temp. lb./(hr. ft.).
- ρ_f Density of condensate film, lb./ cu. ft.
- 1 Subscript 1 refers to reference condition.
- 2 Subscript 2 refers to experimental or design condition.

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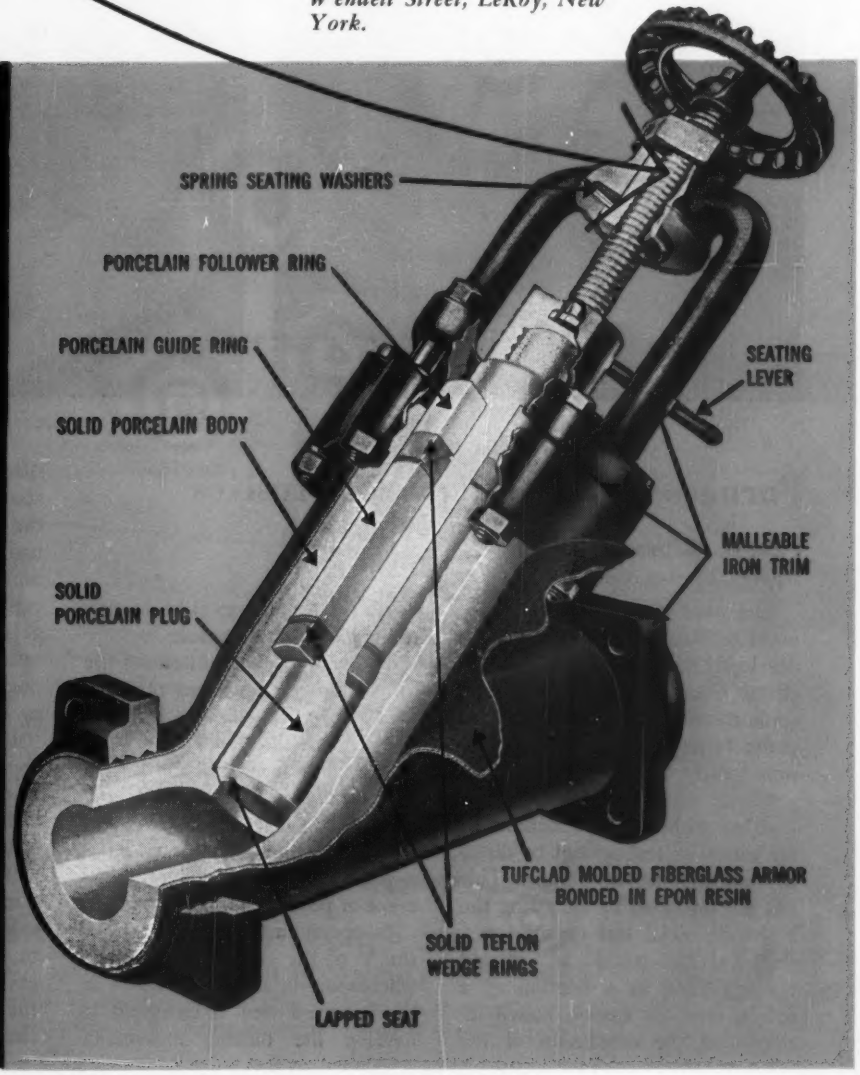

is written for a vapor under two different conditions (1, designating the reference basis with a tube 1 ft. long; and 2, designating the experimental condition), it follows that for a given Δt:

$$h_1 = h_2 L_2^{0.25} \quad (3)$$

The graph presented here was produced by taking a number of experimental condensation film coefficients h_2 of vapors reported in the literature, and reducing them by means of Equation (3) to film coefficients h_1 based on a tube 1 ft. long. The reduced data were then plotted as a function of Δt, and the best lines through the plotted points given on the graph.

To use this plot, take the following example: It is desired to find the condensation film coefficient for chlorobenzene in a vertical condenser having 16-ft. long tubes, when Δt is 40° F. From the graph the value of h_1 for chlorobenzene at $\Delta t = 40°$ F. is read as approximately 248. Therefore, in a condenser with 16-ft. long tubes, the film coefficient achieved would be $248/16^{0.25} = 124$.

Similarly, Nusselt's equation for horizontal tubes can be reduced to:

$$h_1 = h_2 (N_2 D_2'')^{0.25} \quad (4)$$

where D'' is the tube diameter in inches. Taking a single tube of 1-in. diameter as the standard, Equation (4) is useful for process design calculation for horizontal condensers, just as Equation (3) is used for vertical condensers.

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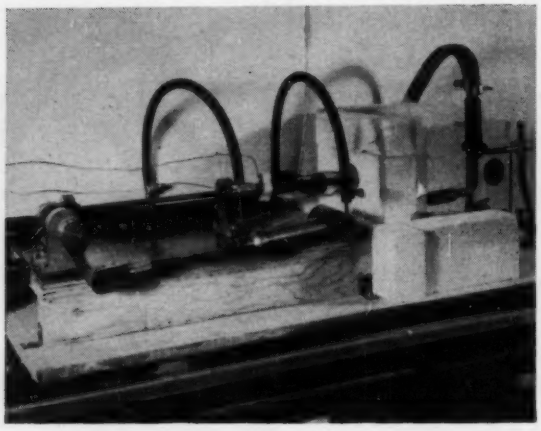

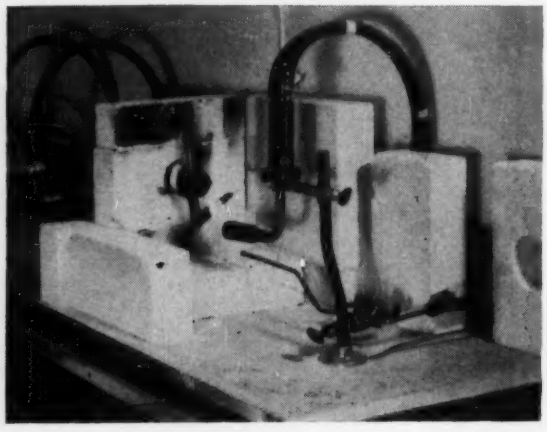

Furnace Tests Metals vs. Corrosives

Paul C. Ziemke
Safety Engineer, Oak Ridge, Tenn.

The photographs above show a novel oscillating furnace which we developed to enable us to study the effects of alternate heat and cold applications on metals in contact under turbulent conditions with a wide variety of corrosive materials.

Object of the apparatus was to simulate turbulent flow conditions for corrosion testing, but to do so without the use of pumps. This was accomplished by mounting the V-shaped metal test capsule on a shaft which could be rotated through 180° in a fraction of a second, and its motion halted instantly at the conclusion of the turning movement so as to develop turbulence in the capsule.

The view at the right shows the furnace proper, consisting of a firebrick enclosure with a propane-gas-fueled torch directed at the V of the capsule when it is at the bottom of its rotation. Ignition is ordinarily by a high-voltage, high-frequency arc at the torch, but a gas pilot is provided as a standby feature in event of power failure.

In operation the gas flame heats the V of the capsule to 800° C., whereupon an air piston shown in the left-hand view is energized to develop the turning movement. After rotation through 180° in about 1/25th sec., during which the molten corrosive material remains in the apex of the V, the motion stops and the liquid is cooled by an air jet to 600° C., at which time the capsule is rotated 180° back to its starting point, and the heating-cooling cycle is repeated.

Control of the apparatus is accomplished by means of two thermocouples, one at the heating end and one at the cooling end of the test capsule. A recording potentiometer controller is arranged to transmit signals to the solenoid valves which control the air supply to the turning mechanism and the gas supply to the torch. During the heating cycle the gas is on and the air piston is at one end of its

Two CHEMICO-designed plants

produce over 900 tons per day of anhydrous ammonia for Lion Oil Company

Production volume at the El Dorado Chemical Plant reached an all time high in 1954. Total of all nitrogen products manufactured for sale increased 10 per cent over the previous year.

Anhydrous ammonia, which is the basic product of the plant and the raw material for the manufacture of other nitrogenous materials, was produced at an average rate of 582 tons per day throughout the year. The comparative figure for 1953 was 576 tons daily with the same equipment.

The Barton Plant near New Orleans, Louisiana, was completed in June, 1954, after a construction period of about 18 months. The manufacturing facilities were gradually brought up to full production and operated at rates above the designed daily capacities of 300 tons of anhydrous ammonia, 430 tons of nitric acid and 550 tons of pelleted ammonium nitrate. This plant was formally dedicated on October 25, 1954, in ceremonies attended by employees, their families and many guests.

Extracts from the 1954 Annual Report of Lion Oil Company, referring to Plants designed by Chemico to produce 900 tons per day of anhydrous ammonia and corresponding amounts of nitric acid and ammonium nitrate.

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stroke. When the high temperature, 800° C., is reached the gas supply goes off, an air blast for cooling goes on, and the air piston and its associated gears quickly turn the shaft and the capsule. Then, when the low temperature of 600° C. is reached, the air piston moves to its other extreme, returning the capsule to its initial position, the gas is turned on and re-ignited and cooling air stopped.

Estimating Thermal Conductivity of Gases

Om P. Kharbanda

Research Dept., Simon-Carves Ltd., Stockport, England

Thermal conductivity of gases is one of the most commonly used properties in chemical engineering calculations. However, particularly at high temperatures, the experimental determination of gas thermal conductivity is tedious and often inaccurate, unless meticulous care is taken.

On the other hand, it is easy to determine the viscosity of gases with accuracy by use of relatively simple apparatus. Furthermore, viscosity data are well known for many gases up to fairly high temperatures. The method recommended here makes use of viscosity data in estimating thermal conductivity data at high temperatures. It requires a knowledge of only one thermal conductivity value at low temperature, which may be determined experimentally or estimated by some other means.

Temperature variation in the thermal conductivity of gases (see McAdams, "Heat Transmission," McGraw-Hill, 1942) follows the Sutherland type equation:

$$k_T = k_{492}\left(\frac{492 + C}{T + C}\right)\left(\frac{T}{492}\right)^{3/2} \qquad (1)$$

where T is the temperature in °R. and C is an empirical constant, called the Sutherland constant. Unfortunately, although called a constant, this quantity does in fact vary with temperature.

An equation of the same form (see also McAdams) is used for viscosity of gases as well:

$$\mu_T = \mu_{492}\left(\frac{492 + C}{T + C}\right)\left(\frac{T}{492}\right)^{3/2} \qquad (2)$$

and for a given gas the same value of C applies in calculating both thermal conductivity and viscosity. By combining Equations (1) and (2), a temperature-independent relation is obtained:

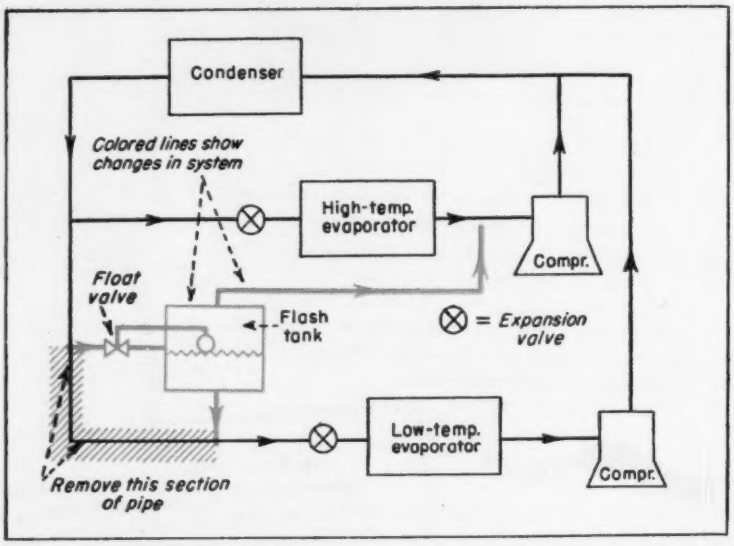
$$k_T/k_{492} = \mu_T/\mu_{492} \qquad (3)$$

The table presented here gives a check on the validity of Equation (3) for some of the simple gases. The equation is, of course, equally valid for any two temperatures. In it the terms include k, the thermal conductivity, in Btu./(hr. sq. ft. °F. per ft.) and μ, the viscosity, in lb./(ft. hr.).

Check on Validity of Equation (3)*

	Temperature, °R.		
	492	960	1,460
Nitrogen			
k	0.0138	0.0225	0.0305
μ	0.0400	0.0640	0.0850
k/k_{492}	1.00	1.63	2.21
μ/μ_{492}	1.00	1.60	2.12
Hydrogen			
k	0.099	0.157	0.208
μ	0.0203	0.0319	0.0419
k/k_{492}	1.00	1.59	2.19
μ/μ_{492}	1.00	1.57	2.06
Carbon monoxide			
k	0.0129	0.0214	0.0294
μ	0.0393	0.0630	0.083
k/k_{492}	1.00	1.66	2.28
μ/μ_{492}	1.00	1.61	2.11
Oxygen			
k	0.0141	0.0246	0.0337
μ	0.0467	0.077	0.100
k/k_{492}	1.00	1.75	2.39
μ/μ_{492}	1.00	1.65	2.14
Air			
k	0.0140	0.0231	0.0319
μ	0.0420	0.0675	0.0892
k/k_{492}	1.00	1.65	2.28
μ/μ_{492}	1.00	1.61	2.13

* Data from "Waste Heat Recovery from Industrial Furnaces," 1948.



Improving a Dual Refrigerating System

W. F. Stoecker

Mechanical Engineering Dept., University of Illinois, Urbana, Ill.

When a refrigerating system with two compressors operates at different evaporating temperatures, installing a flash tank and expanding the refrigerant down to the low pressure evaporator in two steps will cut the power costs.

The reason for the improved economy is that the flash gas from the partial expansion is pumped back to the condenser pressure without the useless expansion to the low pressure.

The arrangement shown in the

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sketch will also increase the capacity of the low temperature system, although it reduces the capacity of the high temperature system very little.

It may be necessary to use a larger valve port in the expansion valve serving the low temperature evaporator, since the pressure differential across the valve is smaller under the new arrangement.

As an example of the possible power saving, a combined system with ammonia as the refrigerant would require about 4% less power than two individual systems with equal evaporator loads, one at 40°F. and the other at 0° F.

Quick Estimate of Heat Exchanger Duty

Royes Salmon

Process Engineering Group, Union Oil Co. of California, Brea, Calif.

It often happens that a heat exchanger of known area is to be used in a new service. Knowing the inlet temperatures of both fluids, it is desired to estimate the quantity of heat that will be transferred. Usually this problem is treated as a trial-and-error calculation.

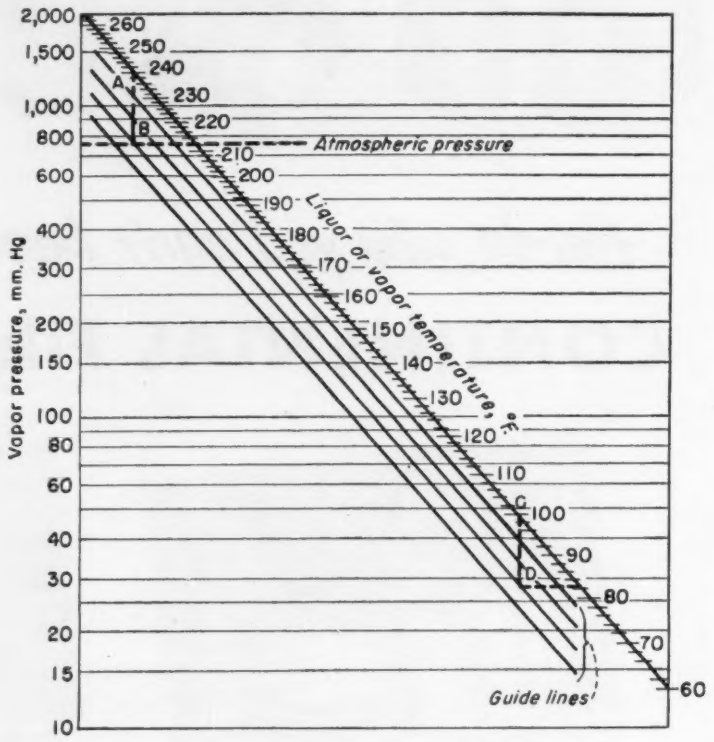
If neither stream changes phase, the following formula will give a quick first approximation of the quantity of heat transferred:

$$Q = \frac{UA\,(T_1 - T_2)}{1 + \frac{UA}{2}\left(\frac{1}{C_1W_1} + \frac{1}{C_2W_2}\right)}$$

where Q = heat transferred, Btu./hr.; U = overall heat transfer coefficient, Btu./(hr. sq. ft. °F.); A = surface area, sq. ft.; T_1 = hot-side inlet temperature, °F.; T_2 = cold-side inlet temperature, °F.; C_1 = hot-side fluid heat capacity, Btu./(lb. °F.); C_2 = cold-side fluid heat capacity, Btu./(lb. °F.); W_1 = hot fluid flow rate, lb./hr.; and W_2 = cold fluid flow rate, lb./hr.

In deriving this equation, arithmetic mean temperature difference was used instead of log mean, and the correction factor for noncountercurrent flow was left out. The Q thus obtained will therefore be on the high side.

The estimation of U, of course, cannot be done accurately until the average fluid temperatures are known. So, the problem still involves trial-and-error. However, in many cases the first approximation will be close enough for estimating purposes.



Boiling Point Rise of Aqueous Solutions

Max Rhoden

Crystallizer Dept., Struthers Wells Corp., Warren, Pa.

In process industries it is often important to know the boiling point rise of aqueous solutions. According to Hougen and Watson's "Chemical Process Principles," Part I, p. 84-5, the vapor pressure of a solution depends both on the solute concentration and on the vapor pressure of the solvent. The factor of dependency on concentration is independent of temperature for many solutions, which means that we can find the vapor pressure of a solution at any temperature, simply knowing the vapor pressure at one temperature. The graph above is based on this principle, enabling us to find the vapor pressure at any temperature of a solution of given concentration, if its vapor pressure is known at one temperature.

As an example, find the vapor pressure and boiling point rise of an aqueous solution at 100° F., if its b.p. at 1 atm. is 240° F.

To use the chart, find 240° F. on the sloped scale (Point A), and drop vertically to 760 mm. Hg (Point B). Using the sloping guide lines, draw a line parallel to the liquor vapor temperature scale until it intersects a vertical dropped from 100° F. (Point C), at Point D. As shown by a horizontal line through D, the vapor pressure is 28 mm. Hg abs. and the boiling point rise is 100 — 82 or 18° F., compared with 240 — 212 = 28° F. at 212° F.

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FIG. 2193—Ni-Resist* Gate Valve for 200 Pounds W.O.G.

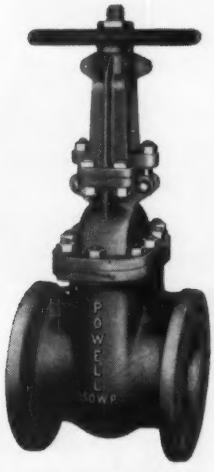
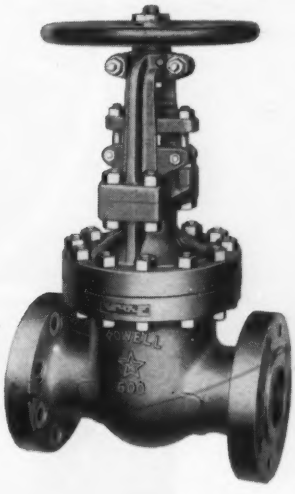


FIG. 2453 G—Stainless Steel O.S.&Y. Gate Valve for 150 Pounds W.P.

FIG. 6003 SS—Alloy Steel Gate Valve for 600 Pounds W.S.P.



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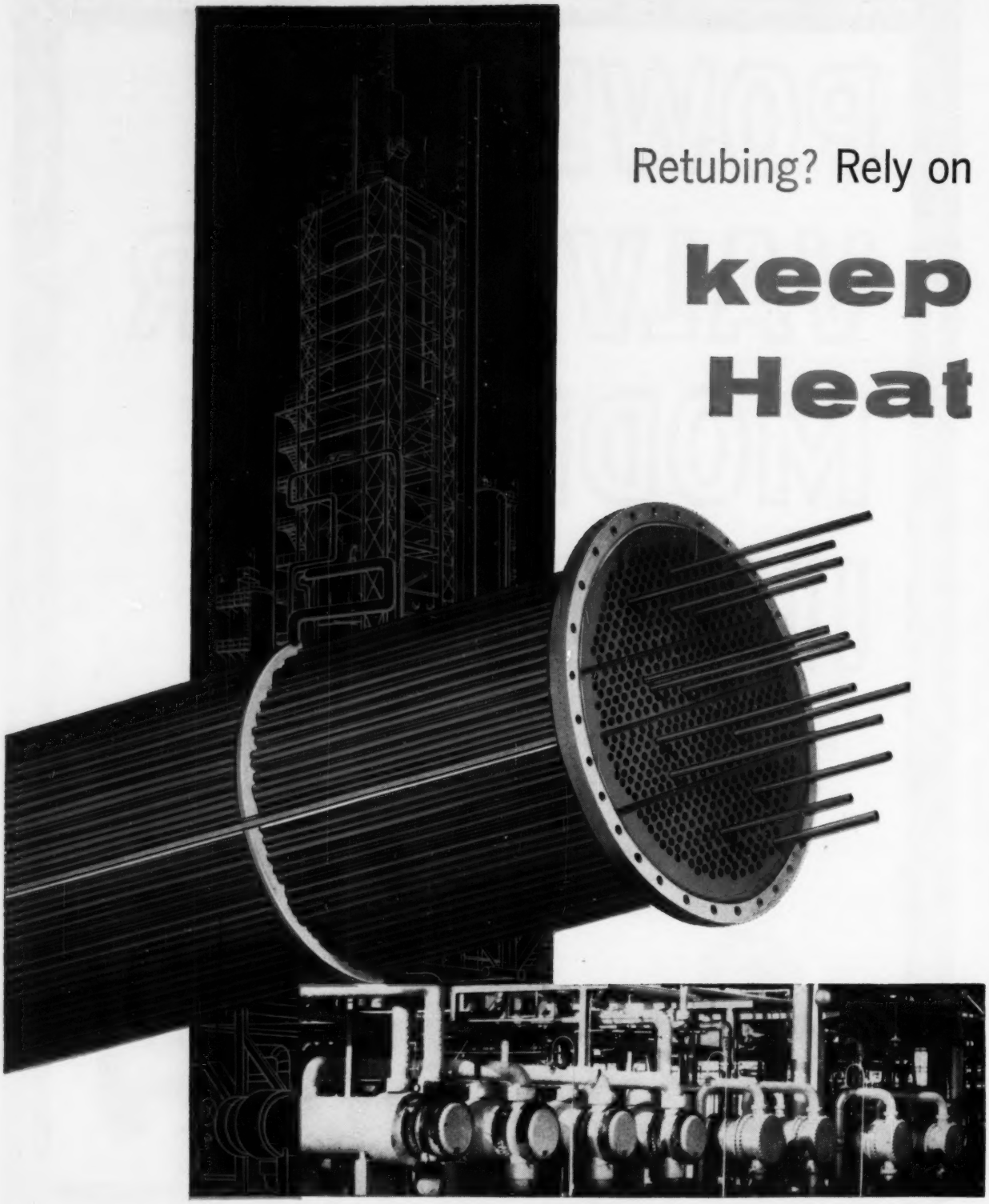

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You and Your Job **Edited by Hugh T. Sharp**

How to Sell Your Next Idea

Skill in communication is probably the greatest single catalyst for your personal advancement.

Neglect in developing this skill often underlies unrecognized and unrewarded work, as well as bogged-down careers.

Success in putting an idea across can result from applying the method given here to your writing and talking.

Chemical engineers who can use their background and abilities to develop constructive ideas and who can then get others to accept these ideas have a running start toward recognition and success.

At every stage of an engineer's career his progress depends on the movement of ideas. In fact, an employer hires an engineer only to get his thinking and put it to use. It's up to the engineer to learn how to transmit his thinking so it can be put to profitable use. If he doesn't he'll cut his effectiveness and hobble his progress.

When an engineer's career begins to bog down, failure to put his thoughts over can usually be counted among the causes.

It Pays Off

As Phil Swain, former editor of *Power*, says in his *Proverbs for Young Engineers*, "Writing and talking are the most common engineering operations. Other things being equal, skill with words will add between $20,000 and $100,000 to an engineer's lifetime earnings."

And important as this skill is in engineering work, it proves even more vital in administrative and executive posts. The greater your job responsibilities, the more you'll depend upon acurate and rapid exchange of information. Your skill at communications and your business fortunes will be closely allied.

The rules of good communication, good idea presenting, apply across the board. Whether you're writing a letter or a memo, delivering a technical paper or talking to the boss, whatever the mode of communication, these rules should guide you.

Essentially the major problem in communication, whether verbal or written, is the same: How to transmit an idea from mind to mind. Although the techniques used by a speaker may differ slightly from those a writer uses, both can approach this problem in the same general way.

Be Audience-Centered

Whenever you prepare any type of communication, verbal or written, it helps to start with your audience, not your subject. Decide on the person or persons you're trying to reach. Then ask yourself, "What does this guy want? How will it help me to get my idea over to him?"

Answering these questions correctly isn't as easy as it looks. It takes a deep insight into human motives, attitudes and aspirations, an insight which can only be gained by constantly listening to and observing others. The better you know your audience the better you'll be able to pitch your ideas to it.

The audience is boss, know what it wants, then put your message in those terms.

How to Get Attention

You're dead wrong if you think that stating an idea, however simply and clearly, is all it takes to put it over to your audience. With ideas, telling nearly always involves selling—against competition Whenever you attempt to get your idea across to others, you must, first of all, compete for their attention.

And you'll face some pretty stiff competition from the thousands of big and little distractions around and within the typical mind. An audience first has to be sold on paying heed to you—before you can even hope to sell it your idea.

Perhaps the best way to gain an audience's attention, and to awaken a response to your idea is to tell how your audience can profit from it. Engineers rarely bother to do this. Generally, they prefer to start a paper, talk, memo or what-have-you with either a historical or a "here it is, the advantages are obvious" gambit.

But remember, nobody has to listen to you or read your material. And few really will unless you make them want to.

Tell Why to Heed

To get your audience with you, give it a reason to heed you, give

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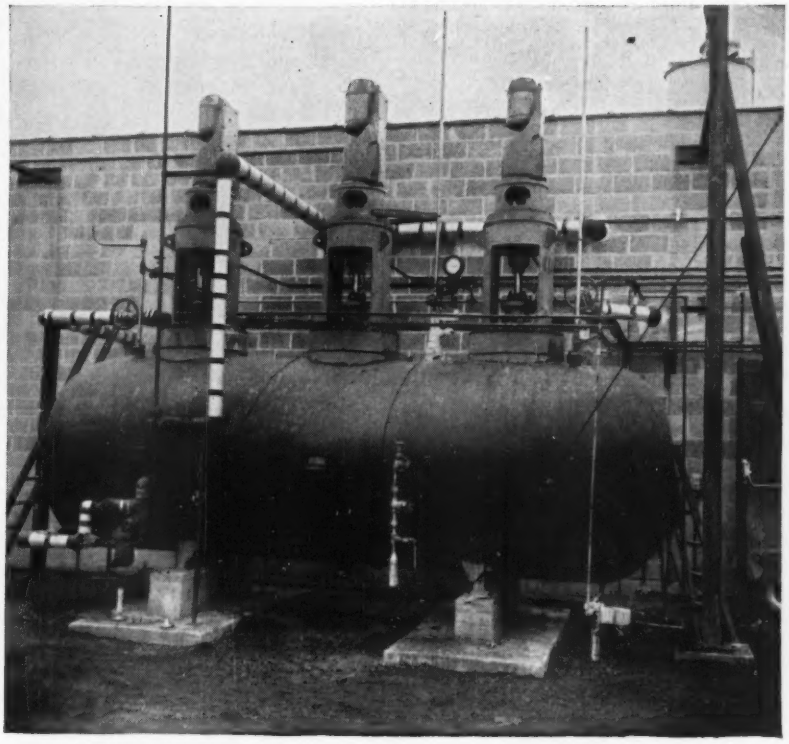

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it fast, keep it simple. Don't save the advantages of your idea till the end. Put them first and you've given the audience a compelling reason to hear you out.

A boss who hears, "I've an idea which I think can save us money." will probably listen. Start in by telling him, "This is the way we run this operation . . . (then all the details). I propose that we . . . (then your idea). This course appears to be more economical, etc." and he'll have had his mind on 101 other things before you tell him why he should listen to you.

Start a memo, "We might be able to get a jump on the competition if we . . ." and you'll win a more attentive reading than if you lead off, "A new packaging device is on the market. It works by . . ."

The same applies to technical papers. As editors of technical magazines know, the quickest way to improve the average paper involves nothing more than moving the last few paragraphs to the beginning. This brings the advantages up to where the reader sees them before he passes the article by in favor of something else which has piqued his interest.

Start on Common Ground

After doping out a way to get attention for your message, plan the message itself to encourage your audience to stay with you. Stop and think. What does your reader or listener know about the subject? What is likely to be his attitude toward it?

In transmitting an idea you have to start with what the audience already knows and build on this common ground. This certainly seems simple enough, but how many papers have you heard or read which were supposedly aimed at you but which started over your head and never did give you a glimpse of what was going on.

One way to prevent this in your writing and talking, involves the liberal use of analogies and examples. This, of course, has long been a favorite trick of topnotch teachers and preachers. And it can help you to fix your thoughts in the minds of others. The more technical and complex your material, the more analogies and examples you should use.

It takes time to work these up —but if you aren't understood you'll have wasted a whole lot more of your time as well as your audience's. Generally, investing time in preparation pays dividends when you come to getting your message over to your audience.

NEXT MONTH:

WORKER RATING

First step in directing the work of others involves sizing up their abilities. October's You & Your Job will bring some practical tips on how to rate your men.

Use This Built-In Illustration

In describing your next idea, stress what's new or unique about it. If it involves a process improvement, say, you'll add impact by pointing up the differences between it and the old.

However, always be sure to tell the old in terms of the new. Don't describe an existing set-up and then suggest your improvement. Rather, bring a description of the existing into your tale of the improvement.

For example: Let's go back to trying to sell your idea to the boss again. You could open the conversation with something like this: "I've been thinking about those lines in Section A, the ones that handle the slurry from the mixing tanks and keep getting clogged up. And I've worked out this new piping arrangement. The bends in the old setup caused most of the trouble, this new layout can eliminate most of them and it has some other advantages. . . ."

Or you could say, "I've an idea which could cut maintenance and up production at the mix tanks. Here's a suggested piping arrangement for the slurry lines, you'll notice that it straightens and shortens them and changes the pitch. This should stop the clogging we've had trouble with. Here are cost figures and an estimate of yearly maintenance savings—they show how quickly it will pay off."

Note that the second tells the old (the clogging of the lines) in terms of the new (the suggested changes). In addition, it gives the boss a strong reason for listening, tells him what it is, what's new about it, why it's better and brings in the disadvantage while indicating how the advantages outweigh it. In about the same length of time, the first has barely flagged the boss's ear.

Stressing the new or unique supplies the momentum which increases the impact of your idea on your audience. Contrasting it with the old puts a built-in illustration in your message. It makes your message many times more effective.

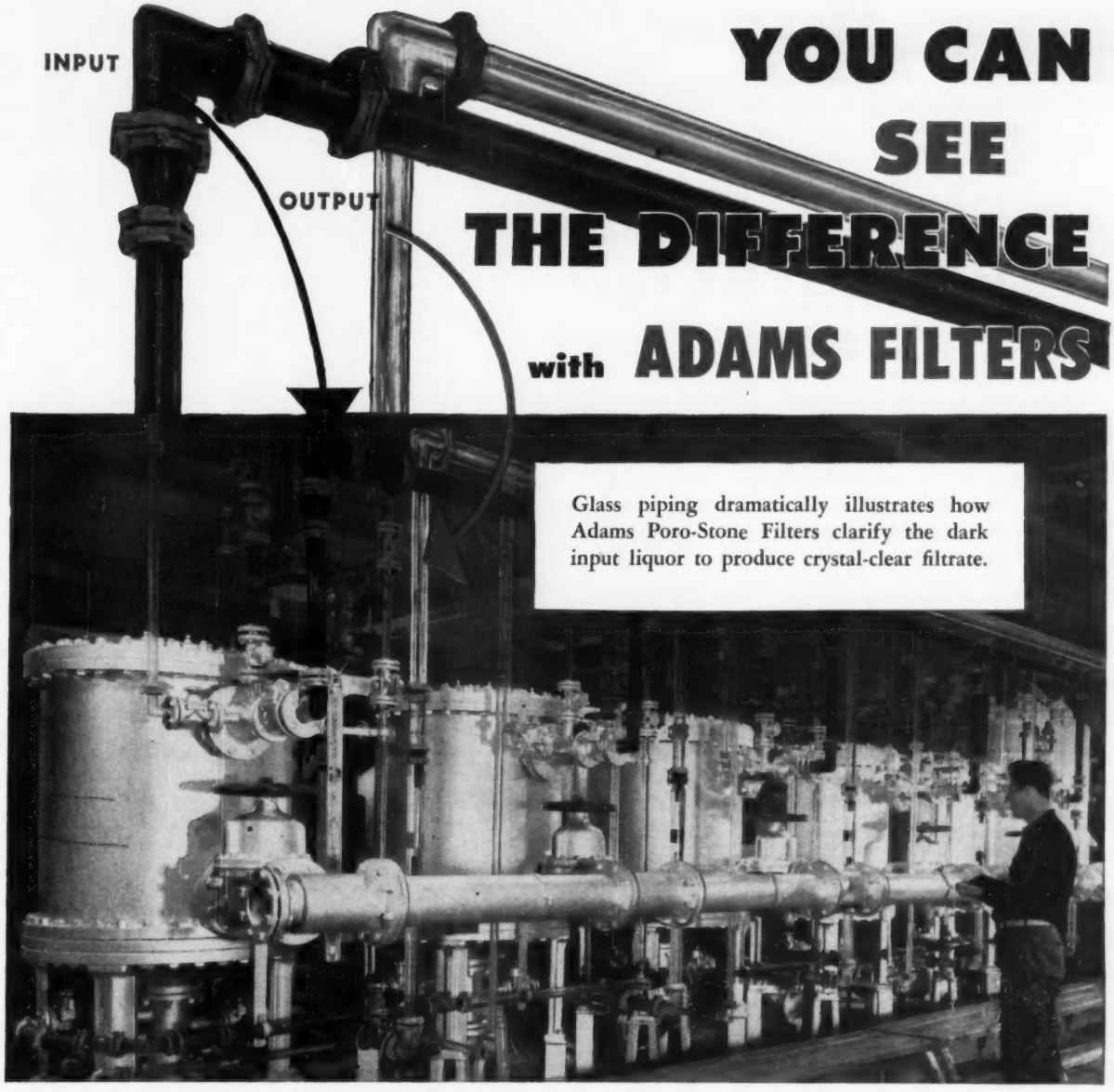
Keep 'Em With You

The words you pick to tell your tale can either encourage your audience to stay with you or to wander off. If you're writing a letter, memo or paper or giving a talk, rein in any impulse to set down those big words, long and complicated sentences and the jargon which passes for a "scientific" style.

If you're out to make a big impression, to show how "learned" you are, okey, let them fly. But if you just want to get your idea over (and, incidentally, create a far better impression), nothing beats clear, simple Anglo-Saxon with short words, short and straightforward sentences and a sparing use of the various parts of the verb "to be."

Using active voice and eliminating the *is's, are's, was's, be's,* etc., will keep your message moving along and encourage your reader to stay with you. It should also encourage you to make specific statements, rather than general observations which admit of a basketful of exceptions.

Let's return for a minute to the concept of using short words. Certainly engineering practice has quite a few many-syllable terms,



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and there's a lot to be said for using them. They're exact and definite and helpful in getting ideas over to other engineers. But passages full of such words slow the reader and snow the listener. Often shorter, more powerful words can be substituted, especially for verbs.

For instance: Why use *accumulate* when *gather* will do? Likewise, you can often substitute *show* for *demonstrate, hasten* or *speed* for *expedite, equal* for *equivalent, ease* for *facilitate, first* for *initial, get* for *procure, buy* for *purchase, next* for *subsequent, end* for *terminate, use* for *utilize* and so on. Doing this pays off in heightened impact for your message and it can transform a simple telling session into a productive selling session.

Telling a Group

In this space in July, 1954, and again last April, Jay R. Gould suggested ways and means of making your written communications do a better job of getting your ideas to your readers. When you prepare a talk or present a paper a few other techniques can help.

After you've written your message using techniques already discussed, you can deliver it by simply reading or memorizing it, by speaking extemporaneously or by combining the two methods.

If you really want to put your idea over, don't read it. Remember, you're trying to transmit an idea. And if you, with hours to prepare, show your audience that you can't keep the main points in mind, the audience can be excused for feeling that it isn't expected to remember those points after a single hearing.

In addition, a head down, word-by-word reading accompanied by periodic page turning can choke interest and stifle enthusiasm in even the most important meeting paper. Why let it happen to yours?

By the same token, don't memorize. It isn't worth the trouble. Memorizing takes time and work in preparation, and the finished product ignores the possibilities for the extemporaneous comments which can add sparkle to speech. Leave the memorizing of lines to actors—your audience will probably be glad you did.

The extemporaneous talk generally makes the most interesting presentation from the listener's seat. But it contains hazards for the inexperienced speaker. No feeling quite compares with the sudden realization that you can't think of another thing to say—and yet you know you haven't covered all you've wanted to. So regard the extemporaneous talk as a well-trapped green on a championship golf course—if you're an expert hit away, aiming right for it; if you're not quite so good, better play it safe.

The safer approach involves outlining or shortening the paper and using this as a speaking guide. Leave out as many of the details as you safely can, and devote your time to socking your main points across. Practice this version a few times to work all of the advantages inherent in speaking: voice inflections, changes in volume and in pace, gestures, a more informal language and so on.

But beware of the handicap your audience holds. The reader can go back to clear up a muddy passage and catch a missed point, the listener can't. Don't further penalize him with a flood of vital points, each surrounded by details. Slow the flow so the listener has time to swallow and digest these vitals.

You can aid his digestion with a liberal dosage of well-thought-out, well-made slides—left on the screen long enough for the listener to learn what they mean. Integrate them into your talk, they'll add life and interest.

Give 'em Something

Whether you write or talk to put your ideas over, wind up by giving your audience some guidance. There's no need to preach, but give them a course of action. If several appear, recommend one and tell why you pick it. Usually this will involve expanding on those advantages you cited at the start.

If you've kept your audience in mind while preparing your message, you've interested it in your idea, you've encouraged it to study your plan as you've unfolded it, now you can close the sale by guiding it in using your idea to its advantage.

This plan holds for all forms of communication. Use it to put your ideas over and you'll find that more of them will score for you. And can you think of a better way to help your career?

GRADUATE STUDY

. . . *Awards Available*

Chemical engineers who plan to acquire an advanced degree would do well to check with the Institute of International Education.* The Institute has been picked to screen applicants for Fulbright scholarships for graduate study abroad for the 1956-57 academic year.

These awards are open to professional people at the pre-doctorial level, who are not now engaged in college or university study. Applicants must also be U.S. citizens, under 35, holders of a bachelor's degree, in good health and able to savvy a foreign language well enough to study in its country.

The program offers opportunities to study in any of the following countries: Australia, Austria, Belgium, Burma, Ceylon, Chile, Denmark, Egypt, Finland, France, Germany, Greece, India, Italy, Japan, Luxemburg, the Netherlands, New Zealand, Norway, the Philippines and the United Kingdom.

Awards to successful applicants cover travel, tuition, books and maintenance for the academic year. Applications close Oct. 31, 1955.

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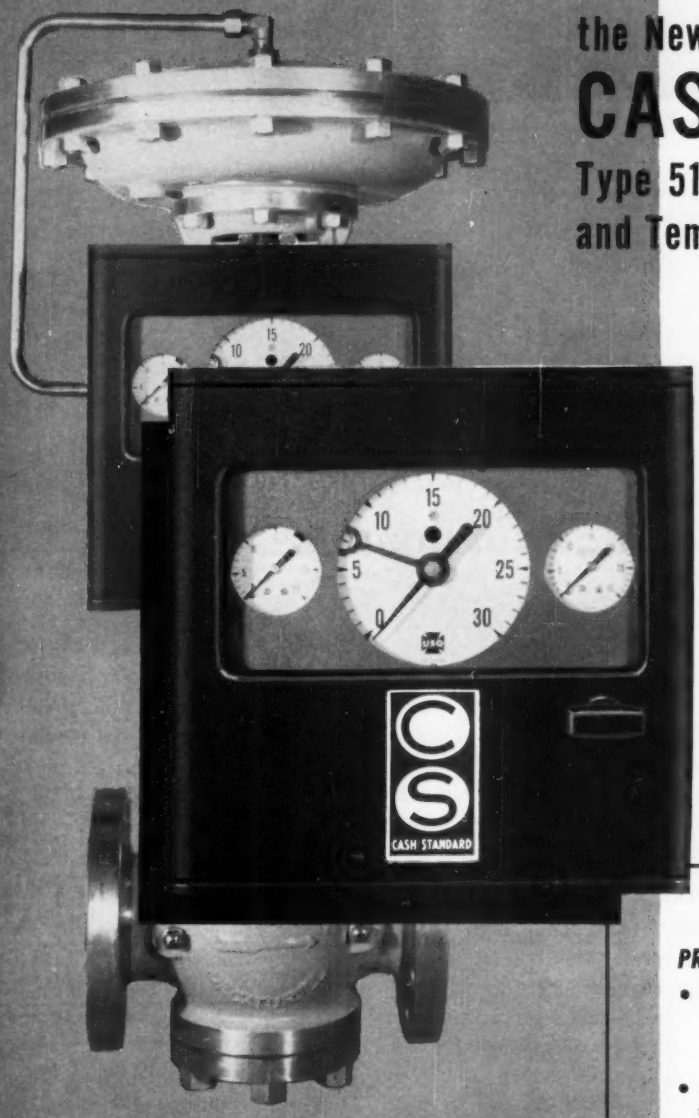

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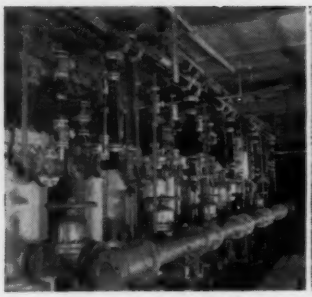
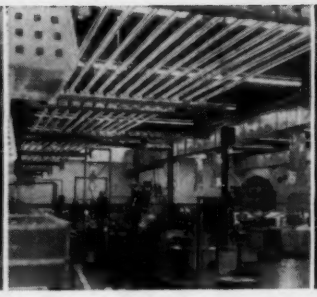
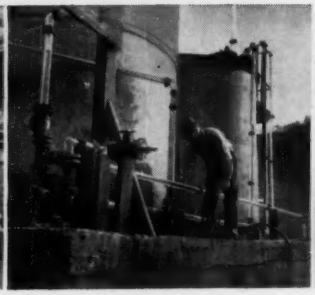


Hydrogen Peroxide



Sensitive Dyes



Chlorinated Hydrocarbons

Disposal of Waste Acid Gases

These 12 users needed the **corrosion resistance** of PYREX pipe

Were they worried about breakage?

Probably.

And if you share the same need and have the same doubts, we can imagine your position.

On one hand, you're plagued by the high-cost and headaches of pipeline corrosion — constant replacement, clogged lines, interrupted production.

On the other hand, nagging doubts keep you from making the one decisive test that could, in time, lead to your saving your company untold amounts of money. The test? An actual installation of PYREX brand glass pipe.

You're afraid it will break.

If you've never had any experience with PYREX pipe, that's understandable. Almost every purchaser of this pipe has had to overcome this fear by logically measuring the value of its corrosion resistance against the possibility of breakage.

How these companies found out

It would be safe to say every one of the 12 companies represented in the pictures went through a worry period before approving the first glass pipe installation.

And most of these installations began in the same way:—buyers installed a *test length* of PYREX pipe. Sometimes it was a length of glass between metal lines; sometimes a length where corrosion's effects would be most brutal and breakage most likely.

Experience banishes fear of breakage

Obviously these companies were satisfied with results, else they wouldn't have PYREX pipe in their plants today—miles of it in some cases, and some of it in use for 20 years.

Tests showed them, as a test would show you, that experience with PYREX pipe banishes fear of breakage—that it is safe for you, too, to take advantage of the tremendous corrosion resistance of glass in your processing lines.

Suppose you tried a test—what might you learn . . .

About corrosion?

You'll find that PYREX pipe does a superlative job with such acids as sulphuric, hydrochloric, nitric, acetic; and with such other chemicals as chlorinated hydrocarbons, hydrogen peroxide, bromine, brines, and low-concentration alkaline solutions.

This chart shows you chemical corrosion rates with representative corrosive chemicals.

CHEMICAL CORROSION RATES—Glass No. 7740

Reagent	Temp. F.	Time, Hours	Weight Loss, Mg per Sq Cm	Inches, Thickness Lost per Year
5% NaOH	212	6	1.4	.36
N/50 Na_2CO_3	212	6	.12	.031
5% HCl	212	24	.0045	.0003
3% NH_4OH*	176	100	.33	.0051
85% H_3PO_4	212	24	.009 to 0.19	.0006 to .0010
H_2O	212	6	.0005	.00013 to .00021
		48	.0066	
5% Sea salt	212	24	.03 to .08	.002 to .005
20% Sea salt	104	100	.025	.0004

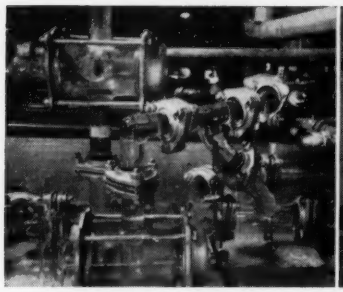
*Maximum corrosion rate for this temperature occurs for concentrations between 0.5 and 3.0%.

About cleaning?

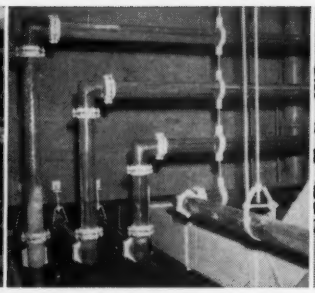
You'll welcome the freedom from slowed-up, sludge-filled lines that PYREX pipe gives you. Hard, smooth glass offers no purchase for costly buildup. And you can clean glass pipe with an acid or detergent agent, live steam or clear water. You *see* when pipes are clean—and when they need cleaning.

About installation?

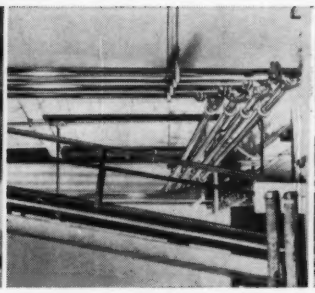
Over 75% of the PYREX pipe now in use has been installed by our customers' own pipe fitters. It's easy to plumb, even with difficult layouts. Hangs easy, too. We have an installation manual to guide your people.



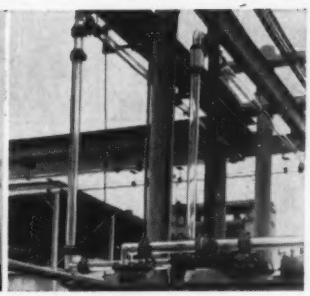
Alkaline Organic Solvents and Muriatic Acid



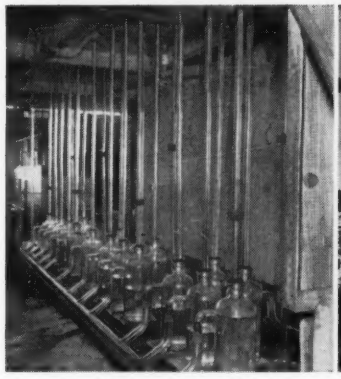
Generating Chlorine Dioxide



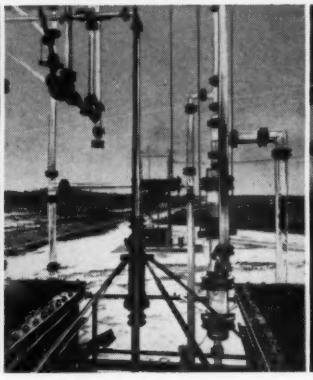
Bottling Plant Lines



Mono-chloro Benzene

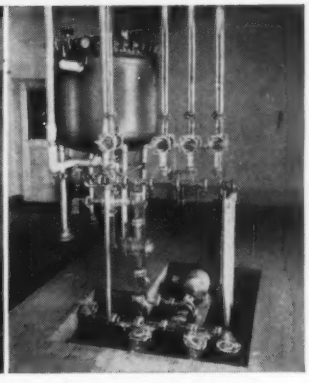


Corrosive Solvents



Hydrochloric Acid

Dilute Nitric - 200° F.



Sensitive Pharmaceuticals

And once PYREX pipe is up, it's up for as long as you need it.

About maintenance?

You'll find maintenance limited to occasional inspection of joints and, once in a while, tightening flange bolts.

About cost?

You'll find the installed cost of PYREX pipe as low as *any* corrosion-resistant material and lower than most. Service life is long. You will probably never need to replace the line you first install. Economy is one of glass pipe's most attractive features.

How YOU can find out more

You can depend on us and upon our distributor in your area (see list) for factual answers to any question you might have about PYREX pipe. Write, wire, or phone us or our nearest distributor or send the coupon below for more detailed information about PYREX brand "Double-Tough" glass pipe.

If you are not now enjoying the trouble-free corrosion-resistance of PYREX *brand glass pipelines because you are worried about breakage, why not talk to some of the people who are using it daily? We'll be glad to furnish the names of companies near you.*

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- ☐ EA-1: "PYREX Pipe in the Process Industries" (Illustrated case histories)
- ☐ EA-3: "PYREX brand 'Double-Tough' Glass Pipe and Fittings Catalog"
- ☐ PE-3: "Installation Manual for PYREX Pipe"
- ☐ Please have your representative call on me.

Name.....Title.....

Company.....

Street.....

City.....Zone.....State.....

"An Amazing Transformation of Properties"

Properties	Conventional Polyethylene	Irradiated Polyethylene
Ultimate tensile strength (Psi. @ 73 F.)	1,900	2,800
Ultimate tensile strength (Psi. @ 300 F.)	0	150
Ultimate elongation (Percent @ 73 F.)	500	670
Ultimate elongation (Percent @ 300 F.)	0	350
Stiffness in flexure (Psi. @ 73 F.)	27,000	45,000
Melting Range (Deg. F.)	230-240	Does not melt
Solubility in xylene (Gm. per cc. @ 195 F.)	35	Insoluble
Deformation under load (Percent @ 270 F., 165 psi., 15 min.)	89	40
Tensile creep ($Cm.^2\ dyne^{-1} \times 10^{-9}$ @ 86 F., 3 hr.)	2.5	1.0
Stress crack resistance	Fair	Excellent

A New Material: Irradiated Polyethylene

New material has better heat resistance, mechanical properties and solvent resistance—while retaining desirable properties of conventional material.

F. J. Bockhoff & J. A. Neumann

The irradiation of polyethylene represents an entirely new concept in the treatment of plastic materials. Consequently, development in the field is rapid and new phases are continually being evaluated. Most of the applications for irradiated polyethylene are still in the experimental stage, and commercial installations of this new material are presently being critically tested under field conditions.

Irradiated polyethylene can be produced by the bombardment of conventional polyethylene with extremely high-energy electrons. This treatment results in an amazing transformation of properties in that polyethylene is changed from an easily fusible thermoplastic to a thermoset material which retains form stability at temperatures as high as 400 F. A definite increase in certain mechanical properties is also noted and these improvements are retained at elevated temperatures. Solvent resistance is increased, and the annoying phenomenon of stress cracking is completely eliminated. Yet, within proper dose limits, irradiated polyethylene retains all of the traditionally desirable properties of conventional polyethylene: toughness, flexibility, impact resistance, and complete inertness in most chemical environments.

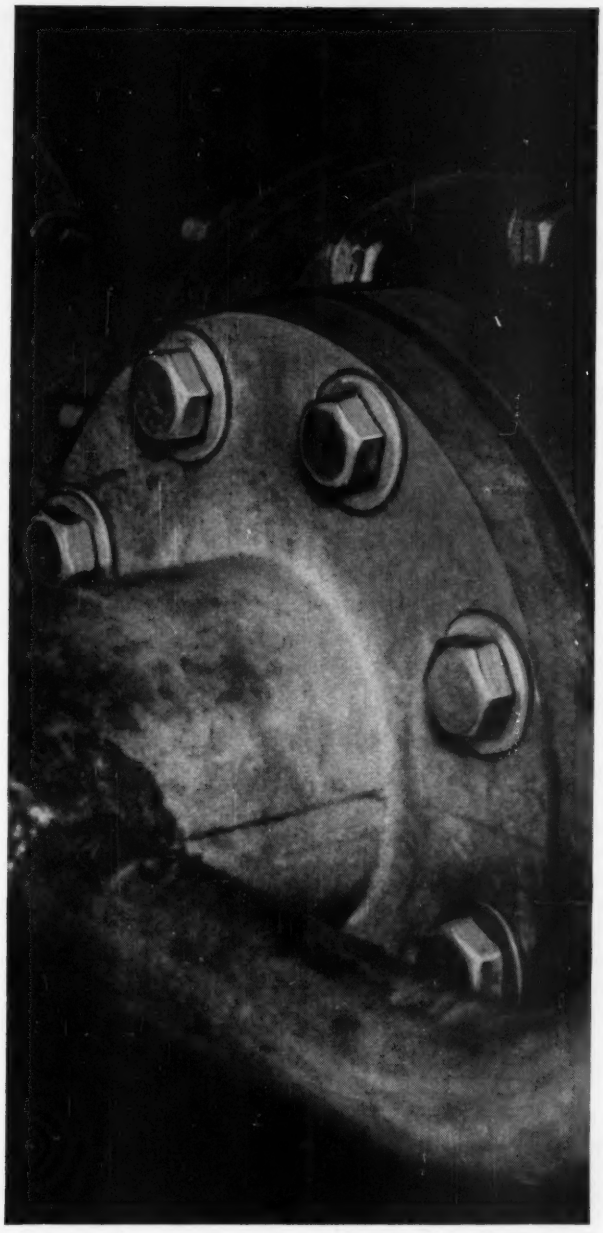
Although any type of high-energy irradiation, including gamma and beta irradiation and isotopes, accomplishes the same end result, electron bombardment appears to be the most feasible type of commercial treatment, both from a control and from an economic standpoint.

When polyethylene is bombarded by high energy electrons, most of the absorption of energy occurs by ionization or electron excitation.[1] This adsorption of energy in the polyethylene molecule leaves the structure with enough excess energy to break chemical bonds. The net effect on the polymer structure depends on the specific bonds which have been ruptured. Polymers can undergo cross-linking or degradation, depending upon this action.

Fortunately, polyethylene is a material in which the carbon-hydrogen bonds are preferentially severed. There is then a reunion of the linear free-radical chains to form a network structure in the polymer. Result is that polyethylene's behavior is no longer like

F. J. Bockhoff *is assistant professor of chemical engineering, Fenn College, Cleveland, Ohio.* J. A. Neumann *is president and director of research, American Agile Corp., Maple Heights, Ohio.*

Fittings stay fastened in Corrosive Acid Spray



PROBLEM:

Selecting fastenings that would hold pipe fittings together in a unit that is constantly subjected to a hot sulphuric acid spray. Bolts were formerly falling apart in four months' time.

REMEDY:

Use of nuts and bolts made of wrought HASTELLOY alloy C.

RESULT:

Fastenings made of HASTELLOY alloy C are still holding many months after ordinary bolts had to be replaced.

HASTELLOY alloy C is the most universally corrosion-resistant alloy available today. In addition to aerated sulphuric acid, it has excellent resistance to such strong oxidizers as nitric acid, wet and dry chlorine, and acid solutions of salts. It is available in nearly all standard commercial forms.

For more information on HASTELLOY alloy C, get in touch with the nearest Haynes Stellite Company Office.

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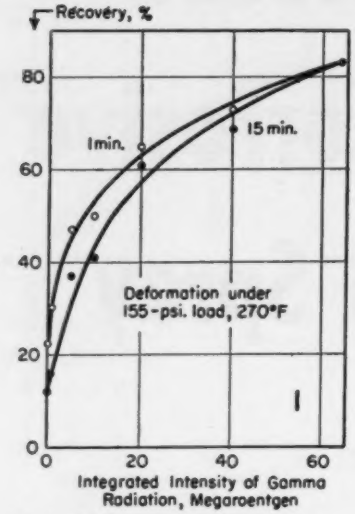
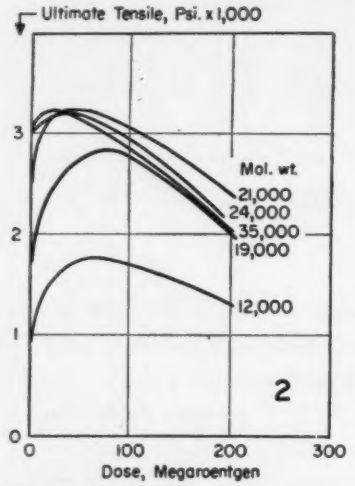
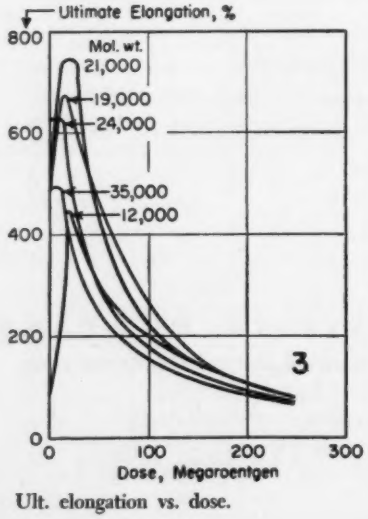


Heat distortion vs. radiation dose.



Ult. tensile strength vs. dose.



Ult. elongation vs. dose.

a thermoplastic, but more like a thermosetting material. Some phases of previous work[8] indicate that cross-linking occurs most probably in side chains of the main polymer molecule.

Effect of over-all dosage is quite important. Although a relatively small amount of irradiation is required to convert polyethylene to a material which will not melt, greater irradiation doses appears to completely suppress cold flow at room temperature. When subjected to very large doses, polyethylene becomes completely amorphous, hard and glass-like even at room temperature. These doses are considerably beyond the beneficial range.

Optimum dose for any given polymer is also a function of the molecular weight and chain branching index of the polymer.

In addition to cross-linking, infrared studies[9] indicate that increases in unsaturation and oxidation[9] occur if the irradiation is carried out in air. Degree of oxidation is a function of the treatment rate and dosage. In practical applications, however, a slight oxidation at the surface of irradiated polyethylene adapts the material for the adhesion of printing inks.

Voltage of the electron beam is quite important in assuring the proper depth of penetration. For a 1 million-volt beam, the depth of penetration from one side only is about ½ cm. Irradiating an object from both sides with a 1 million-volt beam will allow a total thickness of about 1 cm. to be irradiated. Higher voltages increase the depth of penetration in a linear manner.

Over-all effect of electron irradiation of polyethylene is very similar to the effect produced in the vulcanization of rubber—the major difference being that the treatment is much more rapid and emanates from an external source.

Properties of irradiated polyethylene will depend strongly upon the electron dose level. This, in turn, is a function of the specific application for the item to be treated. Typical property values for irradiated polyethylene are given in the table.

Heat Resistance

Perhaps the most marked property improvement is the increased heat resistance. Irradiated polyethylene does not melt at any temperature if the dose level is sufficient. Polyethylene changes from a plastic material to an elastic material above the ordinary crystalline melting range, 230-240 F. The inherent strength of the material is not sufficient at these temperatures for most applications, except those involving short period exposures.

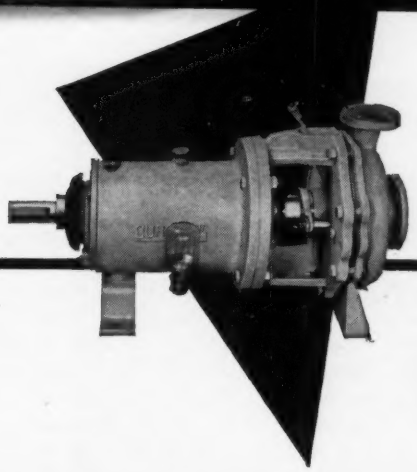
When injection molded articles are treated with electron bombardment, an important factor to consider is the mold cycle used in making these items. Items injection molded on standard fully-automatic equipment are generally under high thermal stress due to shock cooling of the molten polymer.

It should definitely be pointed out that irradiation will not freeze or eliminate these molding strains. Consequently, even though the molded item will not melt at its normal melting temperature, it will deform in an attempt to release this stored stress. For this reason, it is imperative that strain-free molded articles be used for any application in which form stability is desired above the normal melting point. This would include items for such applications as autoclave sterilization at steam pressures above atmospheric pressure.

Nevertheless, strained injection molded items can be recommended for use at temperatures as high as 220 F. This represents a definite advantage over non-irradiated polyethylene and allows boiling water sterilization of irradiated polyethylene items at frequent intervals or over long periods of time.

Although electrical insulators of irradiated polyethylene can be used periodically at temperatures as high as 350 F, continuous operation at these temperatures is not presently recommended due to the oxidation of the polymer. A very concentrated effort is now being directed towards the establishment of suitable anti-oxidants for this particular application.

Fig. 1[8] illustrates the effect of



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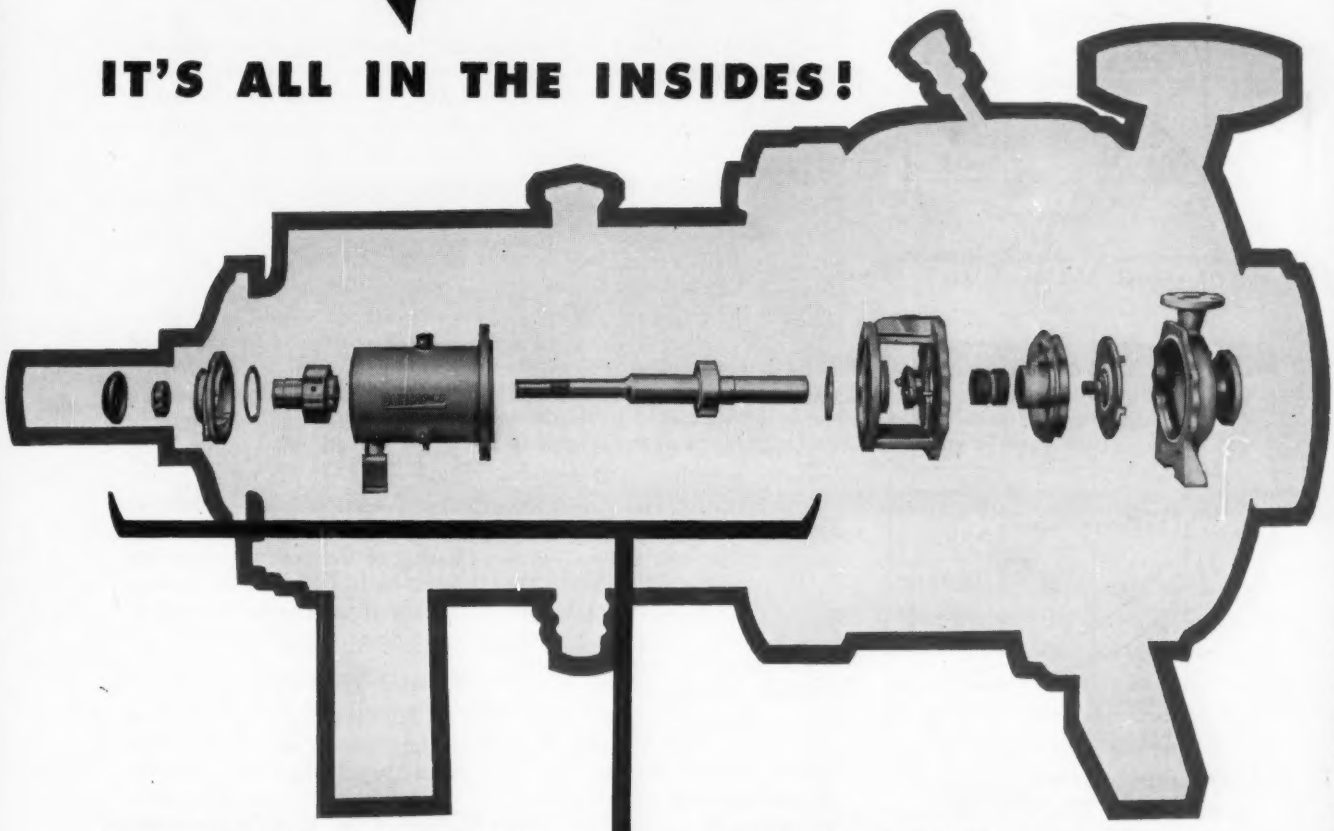

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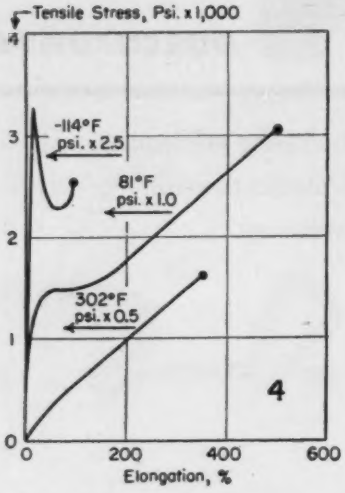
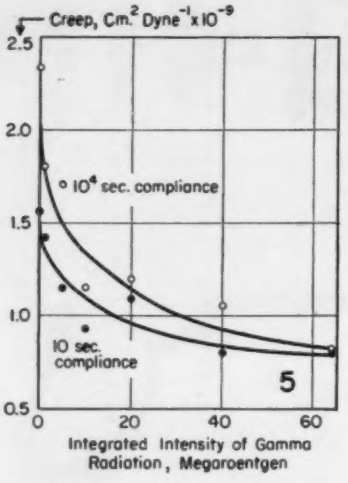


Stress–strain for radiated polyethylene (15 regarep). Mol. wt.–21,000.



Tensile creep vs. radiation dose at 86 F.

irradiation dose on heat distortion at 270 F. Although the effects presented were evaluated for gamma irradiation, the general pattern is the same for electron irradiation.[4,5,6] The deformation is seen to decrease quite rapidly as the irradiation dosage increases.

Mechanical Properties

Mechanical properties of irradiated polyethylene at the proper dose level represent a definite improvement over the mechanical properties of conventional polyethylene. Fig. 2[7] illustrates the effect of irradiation dose on tensile strength for polymers of different molecular weights. It is evident that as the molecular weight increases, the required dose for optimum mechanical properties decreases.

Effect of irradiation dose on ultimate elongation is indicated in Fig. 3.[7] There is a slight increase in elongation up to a dose of about 10 megaroentgen. Above this dose level, elongation begins to decrease. The optimum dose, however, is again dependent upon the molecular weight of the polymer.

Effect on tensile strength and elongation at higher temperatures is illustrated in Fig. 4[7] which represents a set of stress-strain curves for irradiated polyethylene at different temperatures. The irradiated polymer still has a residaul strength of approximately 100 psi. and an ultimate elongation of 350% at 300 F. This strength is sufficient to allow the polymer to retain its form stability at these higher temperatures.

Stiffness at room temperature of irradiated polyethylene, as given in the table, represents a large increase over the stiffness of conventional polyethylene. This again, is largely a function of the molecular weight of the polymer and the irradiation dose.

Tendency for mechanical creep is much less pronounced in irradiated polyethylene than in non-irradiated polyethylene. The effects of integrated field intensity of gamma irradiation on tensile creep are illustrated in Fig. 5.[8] These experiments were performed according to Aiken et al.[8] Creep decreases very rapidly as the irradiation dose increases. The general effect of irradiation on creep at higher temperatures is much more pronounced than the effect given at 86 F. The recovery after tensile creep is also markedly affected by irradiation. Creep recovery curves after 10^4 sec. are given as a function of field intensity of gamma irradiation in Fig. 6.[8] At doses of 10 megaroentgen and larger, creep recovery is complete after 10^4 sec. and is more than 75% complete even after 10 sec.

Chemical Properties

Solvent resistance of irradiated polyethylene is greatly improved over the solvent resistance of ordinary polyethylene. Fig. 7[7] illustrates the effect of irradiation on solubility in toluene at 194 F., as a function of initial molecular weight. Minimum irradiation required to prevent solution of the polymer is given. For the normal usable range of doses, irradiated polyethylene is insoluble in all organic solvents, even at high temperatures. It does, however, swell somewhat in those solvents which dissolve unirradiated polyethylene at the same temperatures.

At room temperatures, irradiated polyethylene retains the excellent resistance of polyethylene to inorganic acids, bases and salts.

Stress cracking, which occurs under biaxial stress in the presence of certain surface active materials[9] is completely eliminated in irradiated polyethylene. Exhaustive laboratory tests have been conducted in an attempt to bring about stress cracking or embrittlement of irradiated polyethylene with no failure evident. The cross-linking of the polymer chains appears to be sufficient to prevent the growth of a fissure or crack in the bulk of the polyethylene.

Electrical Properties

Electrical properties of irradiated polyethylene appear to be somewhat better than the electrical properties of non-irradiated polyethylene at high temperatures. Data of this type are difficult to compare since information on the dielectric properties of molten poly-

NEXT MONTH:

CLAD STEELS

See next month's Corrosion Forum article by Henry F. Peters of Lukens Steel Co. for information about how the clad steels fit into the materials of construction picture. Developed to provide the corrosion resistance, abrasion resistance, and other benefits of the more costly metals at lower cost, the clads employ nickel, stainless steel, Inconel, Monel, or copper bonded to either a carbon or low-carbon steel backing plate.

to

CONTROL CORROSION

where only

MINIMUM SURFACE PREPARATION

is possible

use the

Amercoat 33 over 86 System

There is no substitute for ideal surface preparation. But every maintenance engineer is confronted with corrosion problems in locations where only minimum surface preparation is possible. The Amercoat 33/86 System is amazingly helpful in many of these cases. Here is how it works:

FIRST: apply Amercoat 86 Primer, brushing it well into the surface. This unique primer has a high tolerance for surface contamination and will adhere to many problem surfaces.

- It is both inhibitive and chemically resistant.
- It stifles underfilm corrosion and under-cutting.
- It forms a truly compatible base for vinyl topcoats, eliminating peeling and lamination.

THEN: apply Amercoat 33, the time-tested vinyl coating. Because of its high solids content, you get a thicker, heavier coating—"more mils per gallon". Applied by hot spray* or conventional spray, it takes fewer coats of Amercoat 33 to build the required film thickness.

In addition, you get more economical protection per square foot per year because Amercoat 33 is formulated specifically for maximum chemical resistance and for severe weathering conditions.

**You have the confidence of knowing that more Amercoat 33 has been applied by hot spray than any other vinyl maintenance coating! No need to stock two types of material*

Follow the line of MOST resistance

If you have a difficult corrosion problem in your plant, perhaps we can help you. Our fifteen years of specialized experience is at your service. Write for literature and the name of the trained Amercoat representative in your city.

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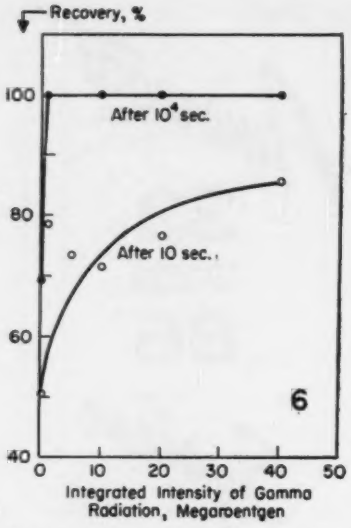
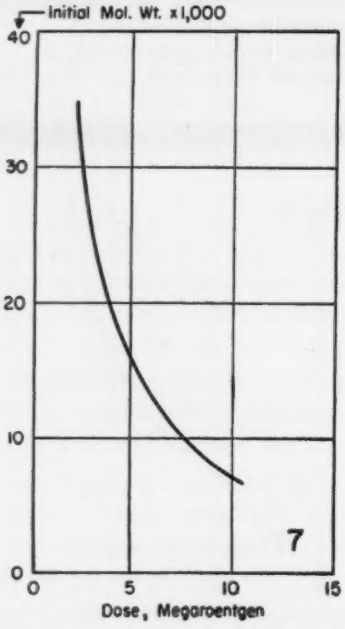


Recovery after tensile creep vs. radiation dose. 86 F.



Minimum dose to make polyethylene insoluble in toluene at 194 F.

ethylene at high temperatures is not readily obtainable.

Applications

The material is advantageously used in the fabrication of items which are to be continually sterilized at boiling water temperatures. This includes certain types of laboratory and hospital ware. Items which have to be sterilized at higher temperatures (at 10 psi. or 240 F.) can be fabricated from strain-free molded items.

Irradiated polyethylene tubing and pipe are corrosion resistant and practically unbreakable, yet have complete freedom from stress cracking. Creep properties of the pipe and tubing are improved considerably. When thin wall tubing is used as a liner in conjunction with steel pipe, the complete line can be periodically cleaned with steam.

Irradiated polyethylene presents a new material for use in corrosion resistant gaskets where temporary high temperatures are encountered, or where continuous temperatures up to 220 F. must be maintained.

The excellent dielectric properties of polyethylene can be incorporated into higher temperature insulators. Continuous use of these insulators, as mentioned previously, is not recommended above 220 F. unless a suitable anti-oxidant is incorporated into the material. Wire coatings of irradiated polyethylene should prove desirable due to their complete freedom from stress cracking. Stress cracking has been a serious problem with previous polyethylene wire coatings. The coating will also withstand a temporary increase in temperature as high as 400 F. without deterioration.

Ability to briefly withstand high temperatures without deformation or oxidation will solve problems encountered in production soldering. Conventional polyethylene coatings melt at most soldering temperatures.

Liners for steel tanks can be conveniently fabricated in irradiated polyethylene by first welding the complete unit and then irradiating. It should be mentioned at this point that in any type of fabrication involving irradiated polyethylene, all fusion operations must be carried out before irradiation, since irradiated polyethylene is no longer fusible and no longer formable by standard thermal methods. A particular advantage of the material in tank lining installations is the resistance to stress cracking in certain environments. In addition, the temperature resistance of the liner is increased to a point where it can be used continuously with boiling solutions.

An outstanding new field for the utilization of irradiated sheet is in vacuum or pressure-formed articles. Above 240 F., irradiated polyethylene behaves as an elastic material. This elasticity is experienced over a wide temperature range. The material behaves much, at these temperatures, like crepe rubber does at room temperature. As a result, in vacuum forming, very deep draws are possible with relatively little temperature control. Wall thickness in sheet formed items is remarkably uniform. Surfaces of sheet formed items of irradiated polyethylene are very smooth in appearance.

In comparison, non-irradiated polyethylene presents many difficulties in vacuum-forming due to its narrow melting range. Smooth-surfaced items are difficult to obtain and wall thicknesses are almost beyond control.

Surprisingly, irradiated polyethylene vacuum-formed articles do not begin to distort or lose their shape until a temperature of approximately 240 F. is reached. This means that vacuum-formed polyethylene articles can be used in boiling aqueous solutions. Extent of this use is difficult to comprehend completely. Many articles which are presently injection-molded will eventually be vacuum-formed in irradiated polyethylene at much less cost. Short-run items which can be heat-formed from sheet, will, of course, represent a very economical method of manufacture.

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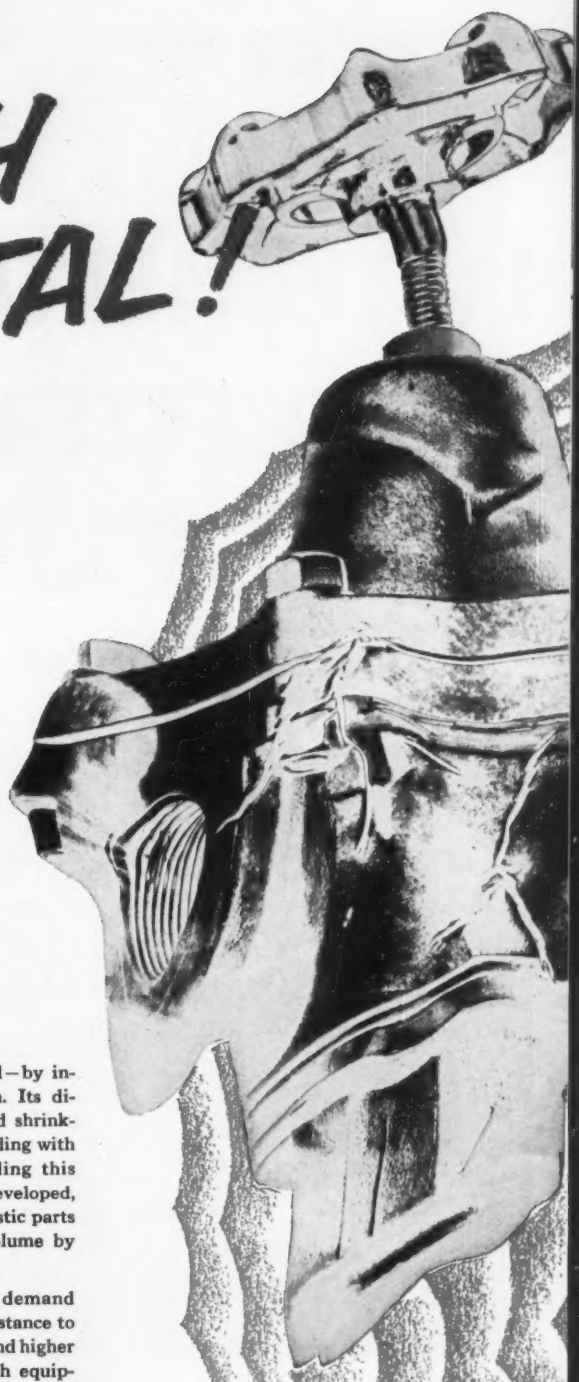
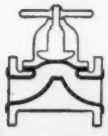
WHEN FLUIDS ARE

TOO ROUGH FOR METAL!



Get the Certain Protection of KEL-F® Plastic

in Valve Linings



Valve Diaphragms

Gaskets

O-Ring Seals

KEL-F Plastic can supply many of the answers to plant equipment corrosion problems. This fluorocarbon plastic is inert to virtually all chemical attack — including mineral acids, oxidizing agents as well as strong caustics.

HIGH COMPRESSIVE STRENGTH

KEL-F Plastic is outstanding for its resiliency and resistance to cold flow. Ring seals and gaskets molded of KEL-F Plastic exhibit a low percentage of deformation under load — retaining seals longer and more effectively.

RESISTANCE TO HEAT AND COLD

KEL-F Plastic has unusually high resistance to temperature extremes — exhibits satisfactory properties over a temperature range of approximately 710° F. (—320° F. to 390° F.)

NON-ADHESIVE

The non-adhesive properties of KEL-F Plastic are advantageous in the handling of viscous fluids, and in maintaining clean, unclogged lines and equipment.

MOLDABILITY

KEL-F Plastic is readily molded—by injection compression or extrusion. Its dimensional stability and low mold shrinkage make it ideally suited to molding with metal. The techniques of molding this fluorocarbon have been fully developed, and perfected. Today, KEL-F Plastic parts and products are produced in volume by molders throughout the country.

Modern processing methods demand plant equipment with greater resistance to corrosion, temperature extremes and higher pressures. The weak links in such equipment are the valves, gaskets and seals. KEL-F Plastic is providing the solution to many of these problems, and producing demonstrable results in reduced downtime and lowered maintenance costs. It is available as a molding compound, or it can be obtained in rods, tubing, sheets and film from a number of suppliers. It is also available in dispersions, suitable for bake-coating on metals and certain non-metals. The full story of KEL-F Polymer should be in your active file. Write us.

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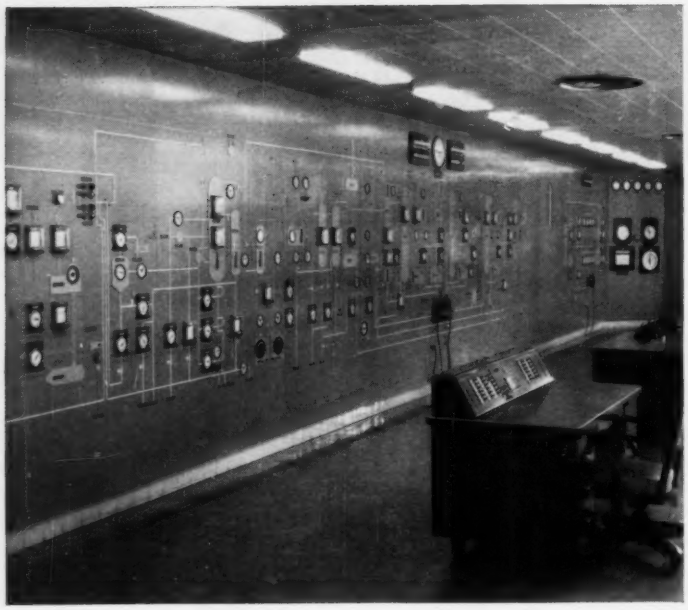
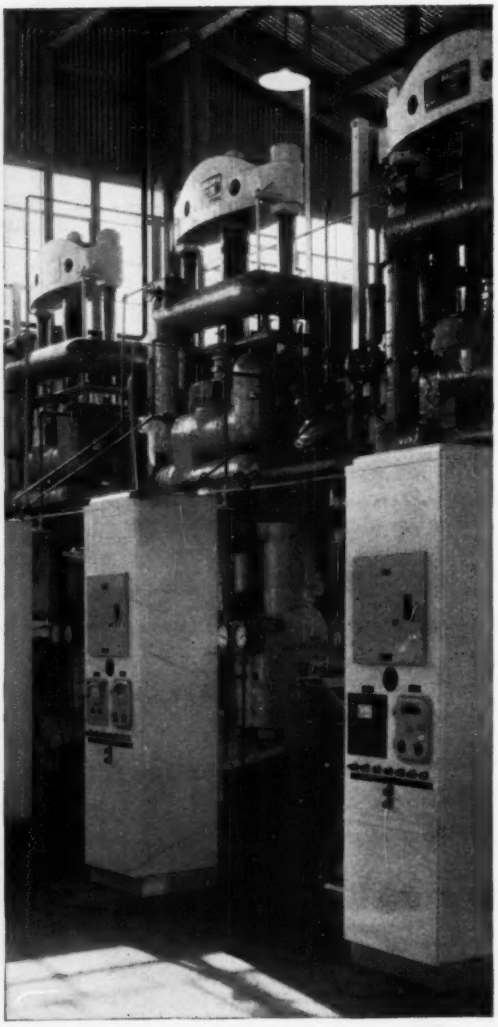
INSTRUMENTATION IS AN OLD WESTERN CUSTOM

. . . that's why Taylor went to California in 1895



Richfield Oil Corporation, Los Angeles. Taylor Transet Plug-in indicators, recorders and controllers on graphic panel for fluid catalytic cracking unit near Long Beach, receiving from Taylor flow, temperature and pressure transmitters.



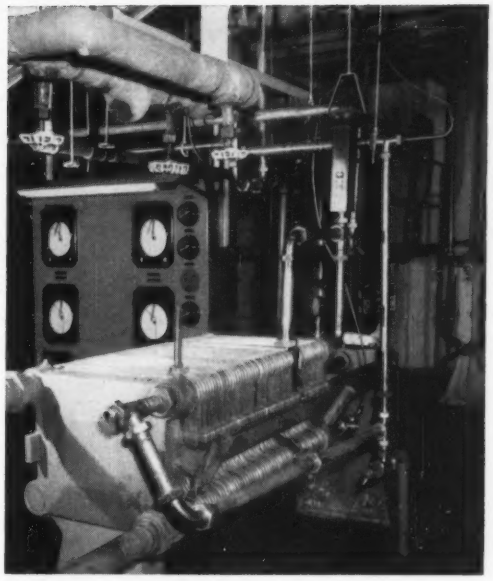
Brea Chemicals, Inc., Los Angeles. Typical of this company's wide use of Taylor instrumentation, the Flex-O-Timers (Time Cycle Controllers) shown here are the heart of automation for operating the dry ice presses at the Brea Chemicals, Inc. ammonia plant. They control the entire sequence of starting, filling, reverting, pressing, ejecting, and stopping.

THE five installations shown on these pages are typical of the instrumentation that is helping Western industries thrive.

Along with these 5 leaders, Taylor Instrument Companies welcome a visit from Instrument Society of America members attending the ISA Instrument-Automation Conference and Exhibit at Los Angeles. Taylor booths B436 - 437 - 438.

Taylor has maintained a plant in San Francisco for 18 years—and has had direct sales representation in the West for 60 years. We're happy to report that we are now in a better position to serve our customers than ever before, with the opening in June of a completely modern plant and sales office at San Leandro, Calif. The new plant is capable of duplicating many manufacturing and repair techniques followed at our main plant in Rochester, N. Y. Personnel-wise, the west coast office is second to none in years of diversified experience and engineering skill . . . our Field Engineers are seasoned veterans in the field of instrumentation. Their advice and help is yours for the asking.

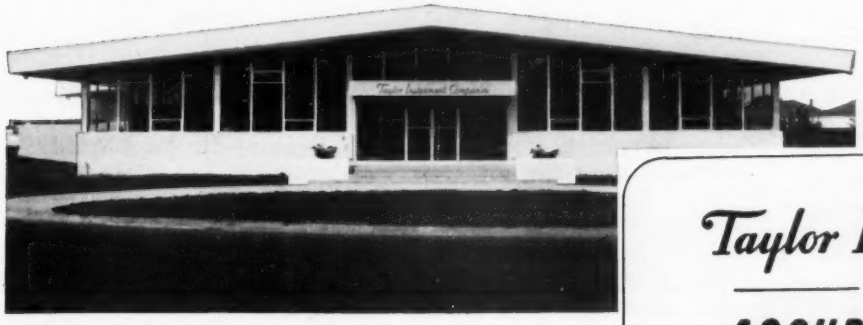
Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.



The Exchange Orange Products Co., Ontario, California. The Taylor controls on their plate-type juice heaters continuously regulate and record juice temperatures. Flow diversion valves automatically return any improperly pasteurized juice for reheating.

East Texas Pulp and Paper Co., Evadale, Texas. These Taylor Digester Control Panels, representative of their many uses of Taylor instrumentation, enable operators at this great new paper mill to produce some of the finest sulphate pulp and top grade paper board in the United States—at competitive prices.

U & I Sugar Company, Moses Lake, Wash. In a beet sugar factory, every B.T.U. must be effectively utilized. The Taylor coordinated control panel (*center background*) operates the multiple effect evaporators at maximum capacity, saves fuel, cuts operator attention time, and assures a uniform product.



Entrance to Taylor Instrument Companies' new offices and plant in San Leandro, California. The plant is capable of duplicating many manufacturing and repair techniques previously possible only at the company's main Rochester, N.Y. plant.

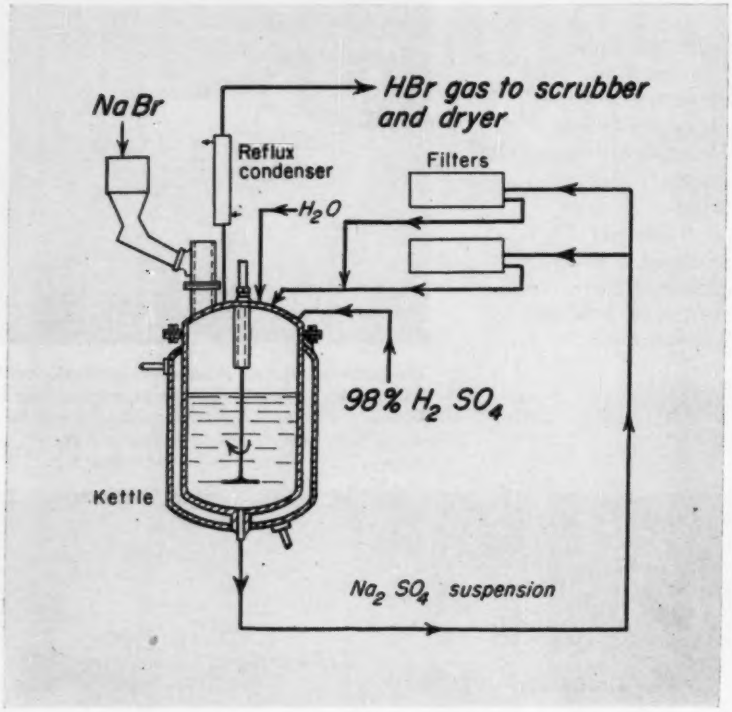
Taylor Instruments

MEAN

ACCURACY FIRST

IN HOME AND INDUSTRY

 Melvin Nord, Chemical Engineer & Patent Attorney, Detroit, Mich.



HBr: Pure, Gaseous

If the weight ratio of water:bromine is kept within specified limits, gaseous HBr can be produced by reacting an alkali metal bromide with H_2SO_4.

Sulfuric acid and an alkali metal bromide replace hydrogen and bromine as starting materials in American Cyanamid's new process for the production of gaseous hydrogen bromide.

Success of the new process hinges on the weight ratio of water to total bromine (present as alkali metal bromide and hydrogen bromide) in the system. This ratio must lie between 1:1 and 1:15. In other words, the weight percent of water should be greater than 6, but less than 50.

▶ **Bromide, Acid React**—In a typical run, 206 lb. of sodium bromide feeds from a hopper, via a vibratory feeder, into a 500-gal., jacketed kettle.

Next, 188 lb. of 52% sulfuric acid is added and the charge heated to boiling (120-130 C.). Any hydrogen bromide-water azeotrope which vaporizes is condensed and returned to the kettle.

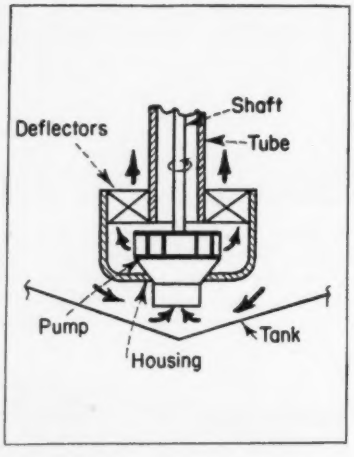
Once the boiling temperature is reached, 98% sulfuric acid is gradually pumped into the kettle. Reaction of acid and bromide liberates gaseous hydrogen bromide. Wet gas passes up through the reflux condenser and out to a gas scrubber and dryer.

After about 90 lb. of the concentrated acid has been added to the system, the vibratory feed is started. And sodium bromide is fed into the kettle at the rate of 103 lb. for each additional 98 lb. of acid pumped in.

▶ **Sulfate Filtered**—As the reaction proceeds, sodium bisulfate forms and accumulates in the kettle. When enough solids have accumulated, some of the sulfate suspension is pumped from the kettle to the filters.

When feed pressure to the first filter indicates that it is full, the filter cake is discharged and the second filter is cut in to the system. Clear filtrate is returned to the kettle.

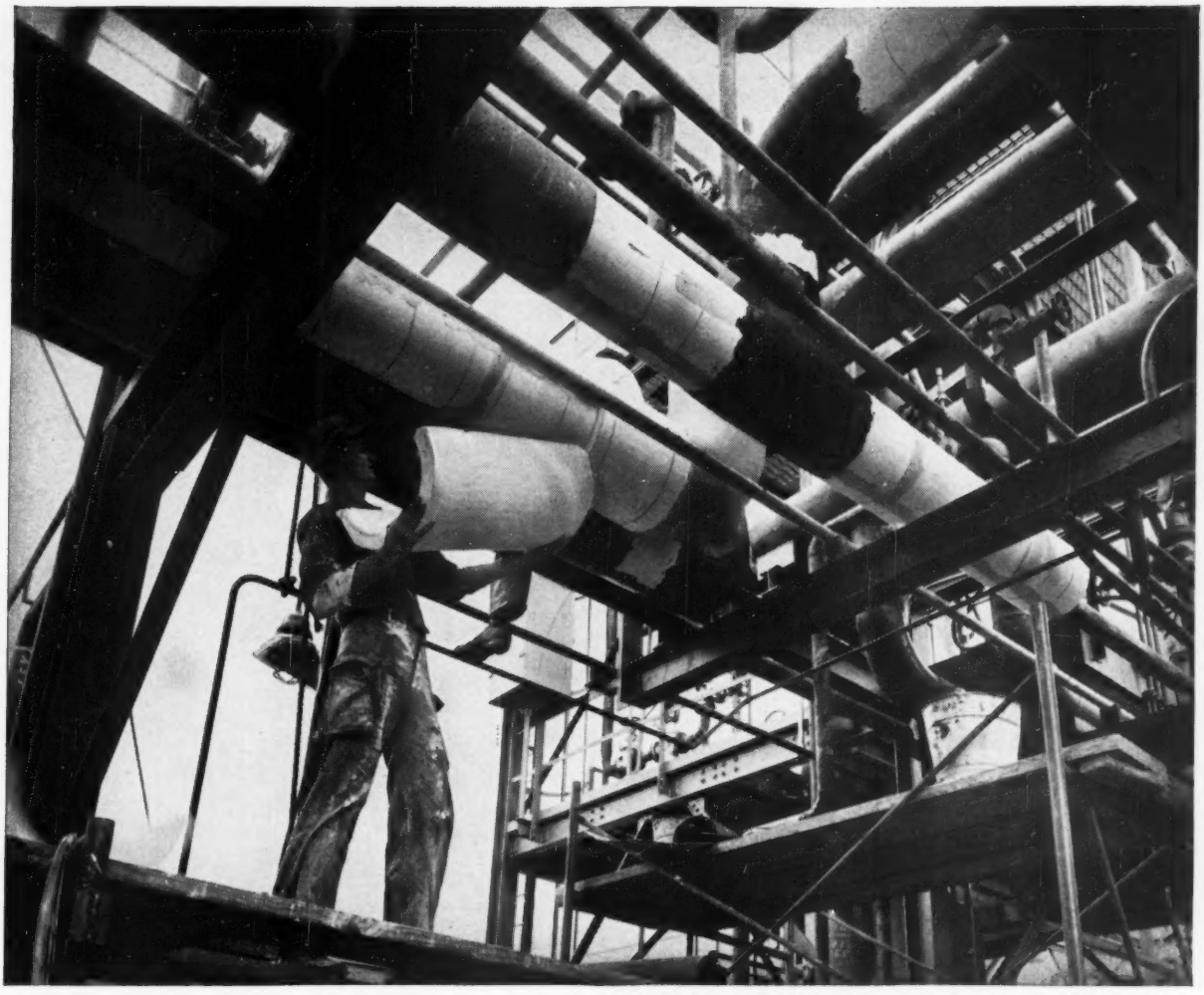
Since the filter cake retains some water, makeup water is added to the kettle to keep the water content of the reaction mixture substantially constant.—**U. S. 2,705,670 by Tsai Hsiang Chao to American Cyanamid Co.**



Deflectors Brake Liquid Rotation in New Mixer

Here's a new mixing device which (1) needs no bottom bearing and (2) doesn't set the contents of the vessel rotating as a whole.

Heart of the mixer is a cylindrical housing which is suspended by a number of guide plates from a vertical tube surrounding the agitator shaft. The housing, open at



J-M 85% Magnesia is lightweight . . . easy for workmen to install half-sections on this 10" steam line. Insulation work at the Grace Chemical plant was performed by Young Sales Corporation of St. Louis. Engineering and construction was directed by Foster Wheeler Corporation of New York.

Your Btu's and dollars go further when you specify **Johns-Manville 85% Magnesia**

. . . the choice of insulation engineers at Grace Chemical's new Memphis plant

INDUSTRY'S LONG-TIME standard for temperatures to 600F is still your best insulation buy. For J-M 85% Magnesia provides high insulating value, easy application, long life, initial low cost and minimum maintenance. That's why insulation engineers consistently specify J-M 85% Magnesia for modern installations like Grace Chemical's new anhydrous ammonia-urea plant. That's why it will pay you to specify J-M 85% Magnesia for your new plant or modernization program.

To assure you maximum value from your insulation dollar, Johns-Manville gives you complete drawing-board-to-job-site service. You get expert recommendations by the world's most experienced insulation engineers . . . plus expert installation by authorized J-M Insulation Contractors. Write today for further information on J-M 85% Magnesia and Johns-Manville's unmatched facilities to solve your insulation problems. Address Johns-Manville Box 60, New York 16, N.Y. In Canada, Port Credit, Ontario.

J-M 85% Magnesia also comes in block form. Here you see it being applied to a vertical drum at a New Jersey petroleum refinery.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville *first-in* INSULATION

MATERIALS · ENGINEERING · APPLICATION

the top encloses a pump wheel.

▶**How It Works**–In operation, liquid is sucked into the bottom of the pump, forced out radially (by pump vanes) into the pump housing, then out between the guide plates (deflectors).

These plates brake the rotation of the liquid, forcing it up and out towards the walls of the vessel. It then flows down along the walls to the bottom and is again sucked up by the pump wheel. And the cycle is repeated.–**U. S. 2,706,622 by Gustaf A. Staaf.**

Separating Aromatics From Non-Aromatics

A novel technique designed to separate aromatics from non-aromatics is based on the fact that the latter are more susceptible to photochemical chlorination than the former.

That this new procedure has proved successful is evidenced by two examples cited in the patent: separation of (1) an olefin from an aromatic and (2) a naphthene from an aromatic.

▶**Olefin-Aromatic**–A typical olefin-aromatic separation involves the removal of thiophene from benzene by spontaneous photochemical chlorination at room temperature.

The reaction is carried out in the absence of catalyst, with slightly more than an equimolar ratio of chlorine to thiophene. Under these conditions, chlorine readily adds on to one of the double bonds in the thiophene molecule.

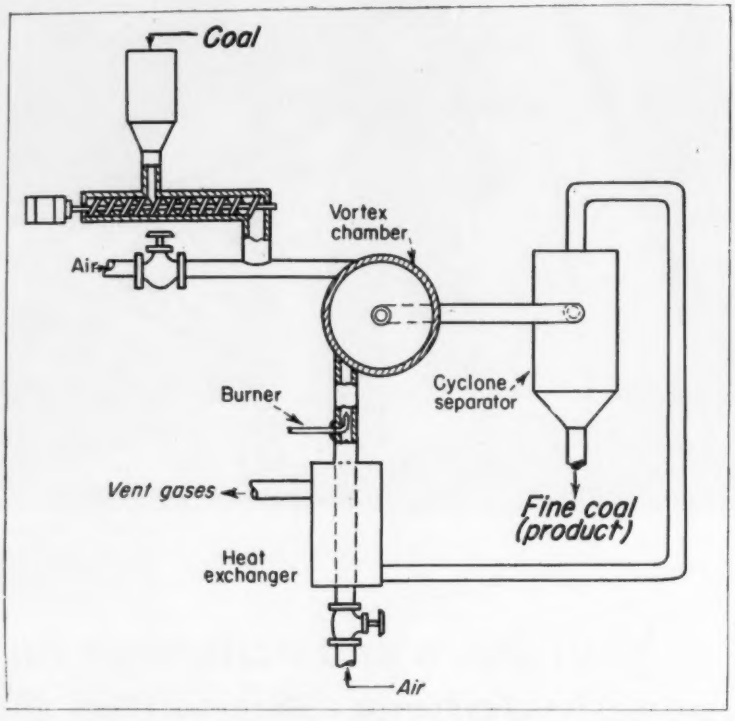
When chlorination is complete, the reaction mixture is washed twice (first, with caustic soda; next, with water), then distilled. Pure, thiophene-free benzene comes off as overhead while 2-chlorothiophene (b.p. 130 C.) accumulates in the still bottoms.

▶**Naphthene-Aromatic**–In a similar manner, a naphthene can be separated from an aromatic. Take, for example, a mixture of 5% cyclohexane and 95% benzene.

The mixture is photochemically chlorinated at room temperature with an excess of chlorine. After both a caustic soda and water wash, the reaction mixture is distilled. Benzene comes off as overhead; chlorinated cyclohexane remains in the still pot.

The inventor also points out that paraffins or naphthenes containing traces of aromatics can be purified by catalytic photochemical chlorination of the aromatics.

To illustrate: In the presence of iron, traces of cyclohexane can be removed from benzene by treating the mixture–at 18-20 C.–with a 2:1 molar ratio of chlorine to benzene. After three washings–water, caustic, water–the reaction mixture is distilled. And pure cyclohexane is recovered.–**U. S. 2,707,197 by Georges J. P. Souillard to Institut Francais du Petrole des Carburants et Lubrifiants.**



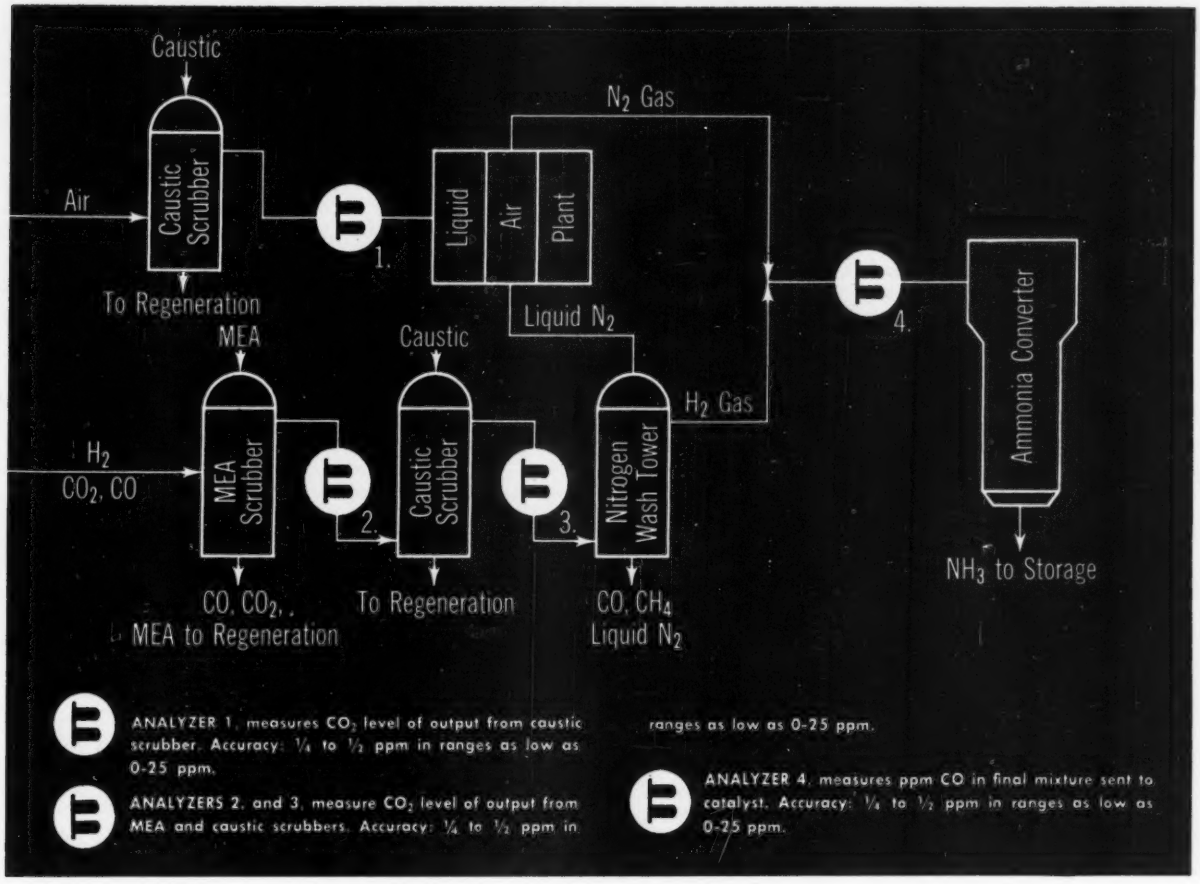
Smokeless Fuel from Volatile Coal

Simultaneous devolatilization and crumbling of coal granules is the key to this new process.

In a new process developed at the Institute of Gas Technology, a medium or high volatile coal (volatile content: 25-38%) is simultaneously devolatilized and crumbled to produce a smokeless fuel. Here's how it's done.

▶**Vortex Chamber**–Pulverized coal granules (size: minus 6-8 mesh) feed from a hopper, via a screw conveyor, into a short, tubular vortex chamber. Simultaneously, air at 400 F. (100 F. below the coal's softening point) feeds into the chamber at a high enough rate to

To get any patents, order from the Commissioner of Patents, Washington 25, D. C. Each patent costs 25 cents.


Caustic
Air
Caustic Scrubber
To Regeneration
N_2 Gas
Liquid
Air
Plant
1.
Liquid N_2
4.
Ammonia Converter
NH_3 to Storage
MEA
Caustic
H_2 Gas
H_2
CO_2, CO
MEA Scrubber
2.
Caustic Scrubber
3.
Nitrogen Wash Tower
CO, CO_2, MEA to Regeneration
To Regeneration
CO, CH_4 Liquid N_2
ANALYZER 1, measures CO_2 level of output from caustic scrubber. Accuracy: ¼ to ½ ppm in ranges as low as 0-25 ppm.
ANALYZERS 2. and 3. measure CO_2 level of output from MEA and caustic scrubbers. Accuracy: ¼ to ½ ppm in ranges as low as 0-25 ppm.
ANALYZER 4. measures ppm CO in final mixture sent to catalyst. Accuracy: ¼ to ½ ppm in ranges as low as 0-25 ppm.

in a 250 ton per day ammonia plant . . .

CONTINUOUS ANALYZERS INCREASE OUTPUT 10%

. . . save $16,000 a year

Perkin-Elmer *continuous* infrared analyzers can increase the efficiency of *your* process – by doing away with "analytical lag," moving the laboratory right out to the process line. Take this example of an ammonia plant.

A P-E TRI-NON* Analyzer (Number 1. in flow diagram) continuously measures CO_2 level–determines optimum balance between caustic use and CO_2 removal efficiency. If NH_3 throughput is 250 tons a day, raising caustic utilization from 70 to 80% or more means a saving of $4,500 to $6,000 a year.

Analyzers 2. and 3. measure the CO_2 level of output from MEA and caustic scrubbers. At this level, the equipment is paid off in less than a year.

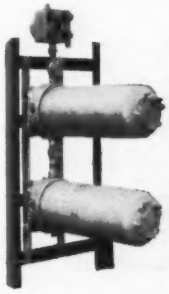
Analyzer 4. measures ppm of CO in final mixture sent to the catalyst. With proper control of CO level, $8,000 to $10,000 can be saved by extending catalyst life. The analyzer pays for itself in 6 months!

When you specify continuous analyzers for your process streams, only P-E has a complete line of instruments to choose from. Or let us develop a complete analytical control system for you. Nowhere else can you get the combination of chemical engineering and instrument know-how that you'll find at P-E. *T. M.

Perkin-Elmer

CORPORATION

Norwalk, Connecticut



P-E TRI-NON Analyzers are available in a wide range of models and prices to meet all types of continuous analytical problems. They are rugged and dependable, expressly designed for use in the varied environments of a processing plant or refinery. For quick and easy maintenance, instrument components can be tested right on stream — without disconnecting.

entrain the pulverized coal particles.

Additional air at 800-1,200 F. is then charged into the chamber to (1) provide a coal:air ratio of 1:1-1:4 and (2) raise the temperature in the chamber to 1,400-1,900 F. At this temperature, coal particles are partly devolatilized and the resulting vapors burned in air. The heat thus liberated helps to maintain the temperature in the vortex chamber.

▶ **Finely Divided Product**—Due to the generation of vapors within the coal, the granules crack to form a cellular structure with thin, fragile walls. Devolatilization—to about 6%—occurs in ¼ to 20 seconds.

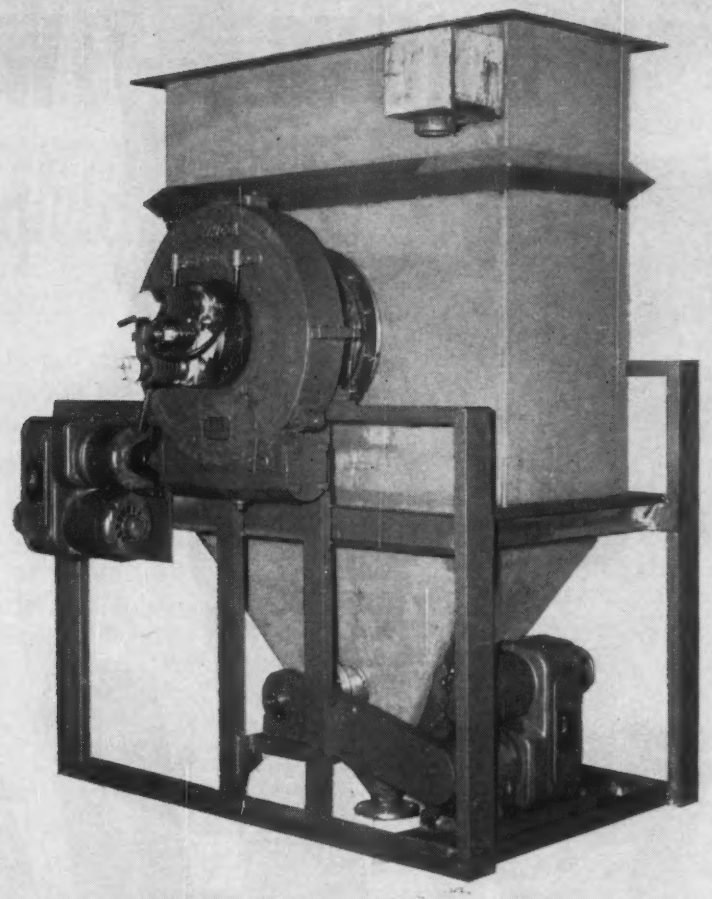
The finess of the product is such that 80% will pass through an 80-mesh screen, 60% will pass through a 325-mesh screen. Hot, finely divided coal can be immediately pressed into briquettes. No binder—e.g., tar—is required.—**U. S. 2,706,706 by Elmore S. Pettyjohn to The Institute of Gas Technology.**

Your Checklist of New Equipment Patents

Operation . . .	About . . .	Inventor or Assignee . . .	Patent No. .
Crystallization	Apparatus for drying, concentration or crystallization of liquids	Niro Corp	2,707,990
Extraction	Apparatus for solvent extraction of oils from solids	Metallgesel'schaft A.G	2,707,712
Extrusion and molding	Plastic molding device	Hollymatic Corp	2,706,830
	Molding plastics	Gene Olsen Corp	2,706,843
	Molds for thermoplastic materials	Telegraph Construction & Maintenance Co. Ltd.	2,707,803
Fluid and particle flow	Fluidized solids reactor	Esso Research & Engineering Co	2,706,704
	Turbo-pump sets	M. W. Kellogg Co	2,707,919
	Lift disengager	Houdry Process Corp	2,708,142
Heat transfer	Heat exchanger for food industries	Graves-Stambaugh Corp	2,706,619–20
	Circumferential seals for regenerative heat exchangers	Air Preheater Corp	2,708,106
Instrumentation and control	Pitot tube	Francis C. Holbrook	2,706,408
	Pitot-tube type flowmeter	Joseph H. Preston	2,706,409
	Liquid quantity indicator for storage tank	Boeing Airplane Co	2,706,410
	Gas pressure differential gage	F. W. Dwyer Mfg. Co	2,707,879
	Device for measuring relative humidity	Minneapolis Honeywell Regulator Co	2,707,880
	Measurement and control of compositions of flowing streams of fluid mixtures	U. S. Atomic Energy Commission	2,707,964
Solid-gas separation	Electrode positioning for an electrostatic precipitator	Apra Precipitator Corp	2,708,007
	Mechanical and electrostatic gas-cleaning device	Research Corp	2,708,008
Solid-solid separation	Turbulence-modifying stirrer for vibrating tables	Ralph Sparks	2,706,560

. . . And New Process Patents

Product . . .	Process . . .	Inventor or Assignee	Patent No. . .
Carbon	Treating furnace carbon blacks	Columbian Carbon Co	2,707,672-4
Catalysts	Dehydrogenation process and catalyst	Continental Oil Co	2,708,210
Fuels	Domestic gas production	Hercules Powder Co	2,707,147
	Preparation of a fuel gas which is interchangeable with natural gas	Institute of Gas Technology	2,707,675
Gases	HCN production	Freeport Sulphur Co	2,706,675
	Converting fluorine to hydrogen fluoride by superheated steam	U. S. Atomic Energy Commission	2,706,676
Hydrocarbons	Gasoline from oils via two-stage destructive hydrogenation	Badische Anilin- & Soda-Fabrik A.G	2,706,705
	Catalytic conversion of hydrocarbons	California Research Corp	2,706,741
Inorganic chemicals	Concentration of phosphate ores	Minerals & Chemicals Corp. of America	2,706,557–8
	Flotation concentration of potash ores	Minerals & Chemicals Corp. of America	2,706,559
	Alumina production	Kaiser Aluminum & Chemical Corp	2,707,669
Metals and ores	Recovery of titanium metal	E. I. du Pont de Nemours & Co	2,707,149
	Titanium metal by electrolysis	Horizons Titanium Corp	2,707,169–70
	Zirconium and titanium production	Westinghouse Electric Corp	2,707,679
	Titanium production	Eugene M. Smith	2,708,158
Organic chemicals	Separation of cumene from cumene hydroperoxide	M. W. Kellogg Co	2,706,708
	Photochemical chlorination	Badische Anilin- & Soda-Fabrik A.G	2,706,709
	Production and separation of sulphonated cpds.	British Petroleum Co. Ltd	2,706,736
	Glutamic acid recovery	International Minerals & Chemical Corp	2,706,737
	Preparation of solid diazonium salts	General Aniline & Film Corp	2,707,181
	Carbon disulfide production	Food Machinery & Chemical Corp	2,708,154
Resins	Melamine from dicyanodiamide	Suedddeutsche Kalkstickstoff-Werke A.G	2,706,729
Rubber	Chloroprene emulsion polymerization	E. I. du Pont de Nemours & Co	2,707,180
	Steam-curing frothed latex	U. S. Rubber Co	2,707,804
	Making an adhesive composition containing a diene rubber and phenolic resin	Minnesota Mining & Mfg. Co	2,708,192
Synthesis gas and products	Extractive distillation of oxygenated organic cpds.	Esso Research & Engineering Co	2,706,707
	Production of unsaturated hydrocarbons and oxygen cpds. of hydrocarbons	California Research Corp	2,706,740
	Hydrolysis of aliphatic esters from synthesis reactions	Texas Co	2,707,192
	Hydrocarbon synthesis	Esso Research & Engineering Co	2,707,713
Synthetic fibers	Melt spinning of acrylonitriles	E. I. du Pont de Nemours & Co	2,706,674
	Pigmentation of viscose	Manufactures de Produits Chimiques du Nord Etablissements Kuhlmann	2,706,689
	Melt spinning	Celanese Corp. of America	2,707,306



Another Eimco Continuous Vacuum Filter

The machine pictured is built as two different machines. One contains a drum type filter with a top feed for drying sand or other crystalline materials. The other contains a disc type thickener filter which runs completely submerged. It is built with a large port for carrying the clarified product or filtrate and a small port arranged to admit a small amount of blow at the bottom sector for dislodging the thickened material so that it can be discharged at the bottom of the tank.

These are special filter applications and examples of developments in liquid-solids separation through filtration.

Eimco, with more than half a century of experience in serving the process industries, makes drum, disc, pan, pressure, plate and frame and tubular type filters with numerous attachments that can be applied to processing industries with difficult filtration problems.

Write for complete information.

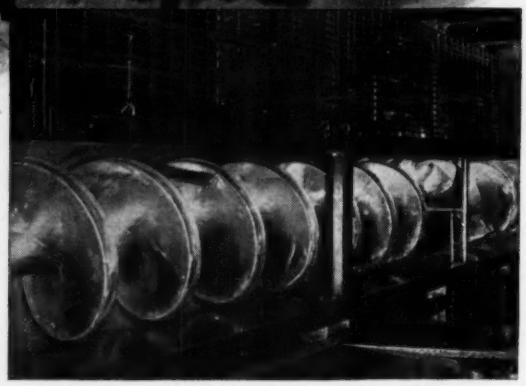
THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-140

BOILING WELDED proves



REPUBLIC ENDURO STAINLESS STEEL DOES A BIG JOB in this "Thermascrew," a screw conveyor with wide uses in chemical and food-processing. Here Enduro transfers heat or cold through the hollow shaft while the screw is totally immersed in the material being processed. Heat or cold loss is minimized, compared with heating or cooling the outside of a vessel or using a static immersion unit.

REPUBLIC STEEL CORPORATION
3116 East 45th Street,
Cleveland 27, Ohio

Please send me more information on:

☐ Stainless Steel Tubing and Pipe ☐ Stainless Steel–Flat Rolled
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STAINLESS STEEL TUBING IN ACID

the Weld is Corrosion Resistant!

Maybe you're one of the few people who hasn't fully accepted that idea up to now. Here's what we do to prove it.

We take a piece of standard Republic ELECTRUNITE Stainless Steel Tubing and put it into a 20 per cent hydrochloric acid solution. Then we let it boil.

When we take it out, the wall thickness has been reduced from .089 inches to .059 inches.

But the weld area is only reduced to .068 inches.

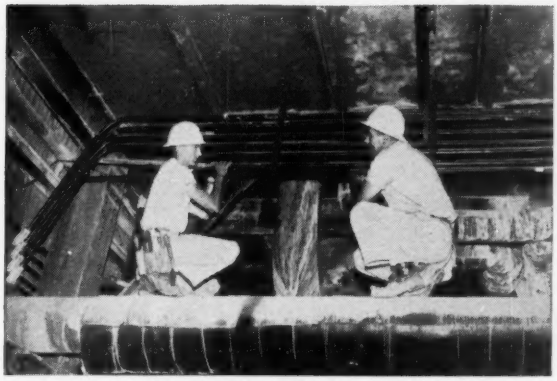
Proof: the weld area is not subject to preferential corrosion.

This is an accelerated lab test. We realize it's only one proof. But we also have on-the-job proof in chemical plants and refineries all over the country, where ELECTRUNITE welded stainless steel tubing is used. And processing corrosion is among the most severe.

The fact that we've been supplying electric resistance welded stainless steel tubing and pipe to process industries for the past twenty-five years means something for you. Find out exactly how much by calling your nearest Republic district sales office. Better yet, fill out and mail the coupon below.

REPUBLIC STEEL

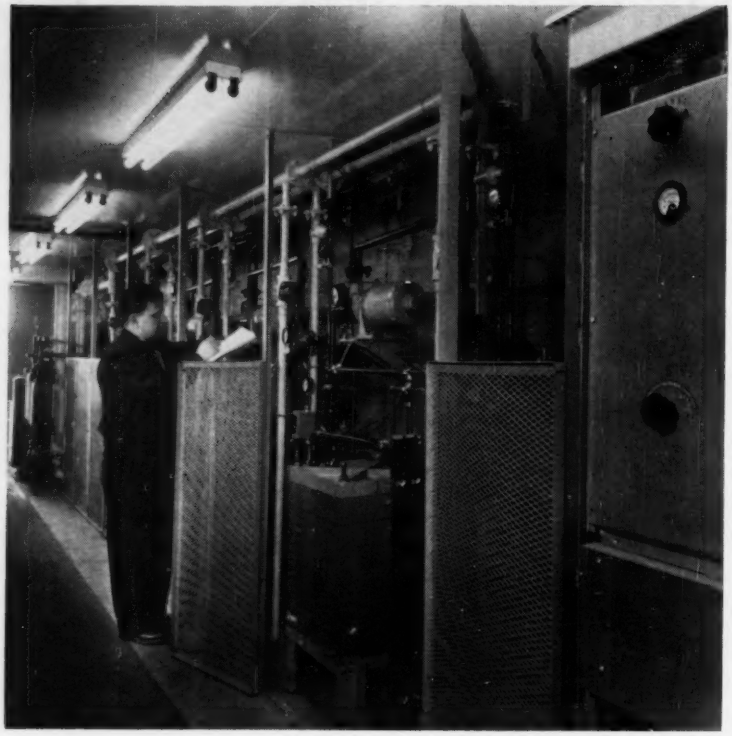
World's Widest Range of Standard Steels and Steel Products

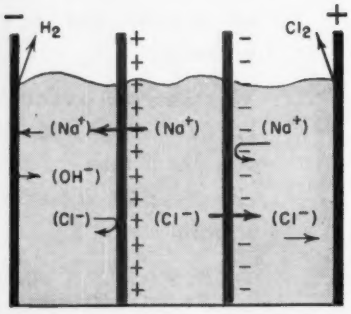


IF YOU HAVE SEVERE CORROSIVE CONDITIONS like these at Kaiser Aluminum & Chemical Corp., Baton Rouge, La., Republic Dekoron-Coated Electrical Metallic Tubing or rigid steel conduit is the answer. This is galvanized steel with a coating of polyethylene, which gives electrical raceways double protection from end to end. Installation is easy. Connections between lengths are protected by vinyl or plastic tape.

YOUR PRODUCT CAN BE AS STRONG AS STEEL, yet weigh only 56 per cent as much. How? If it's made of Republic Titanium or Titanium Alloy. This high strength-to-weight metal, which is also unbelievably corrosion resistant, is now available in all commercial forms. And Republic has been working with it since 1948. We will tell you how and where to use it profitably. (Above: forged compressor rotor.)

NEW PROCESSING EQUIPMENT . . .





HEART of the water demineralization system is an electrolytic membrane cell that controls migration of ions.

BASIS for control is choice of membrane that is permeable to only one ion moving in one direction. Water can't pass.

Transfer Ions to Desalt Process Water

First commercial electric membrane units now generally available to demineralize from one to 100 thousand gal. per day of water. Costs are favorable.

Three years ago use of electric membranes to demineralize water was a new and novel idea. Since then the process has undergone some intensive development and testing. Now that this phase is completed, perfected demineralizers are available in two basic models with a wide range of capacities.

▶ **Where Does It Fit?**—The electric-membrane demineralizer fills the need for water in areas where it's difficult to obtain fresh water but where brackish or mineralized water abounds. These are locations where water now must be distilled, transferred long distances by pipelines, hauled long distances by truck or ship, or stored from seasonal rainfall.

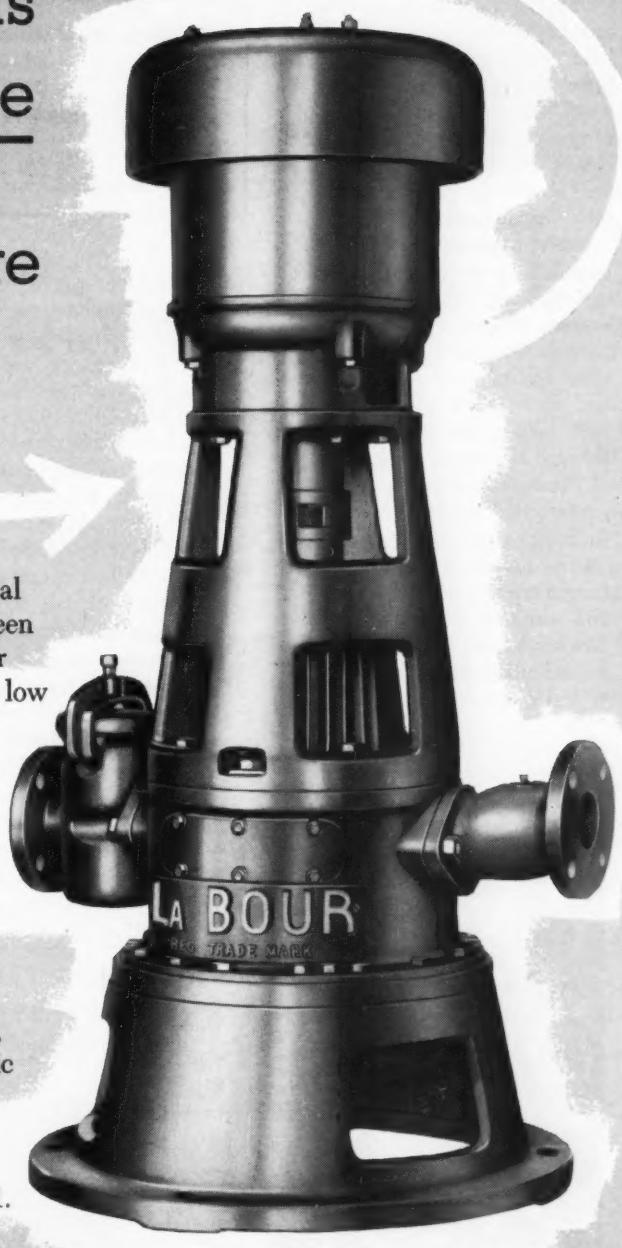
▶ **Cost**—Total cost of fresh water produced from electric-membrane equipment in the moderate size range (1,000 to 100,000 gal. per day) is lower than the cost of water produced by any of the methods indicated above.

Investment costs per gal. per day of capacity vary from as little as $0.50 for removing 40% of salts and minerals to $2.00 or more for 87% removal.

Chief operating cost is for the consumption of electrical energy which varies in proportion to the salinity of the water being treated. For each 1,000 ppm. removed approximately 7 kwh. is required per 1,000 gal. Thus, sea water will require 50 to 150 kwh./1,000 gal.; 5,000-ppm. brackish water, 20 to 30 kwh./1,000 gal.; 2,000-ppm. brackish water, 7 to 12 kwh./1,000 gal.

▶ **Reverse Approach**—The electric membrane process differs basically from other demineralization methods—it removes salt from water rather than water from salt. Distillation, freezing and pressure membrane methods operate primarily on the water, leaving behind a salty stream. They must move from 25 to 1,000 times as much material as the electric membrane process in order to produce a given amount of fresh water.

Now - - - this dependable pump fits many more applications



In the past eight years the chemical industry throughout the world has seen LaBour Type G hang up record after record for uninterrupted service and low or non-existent cost for repair parts. Now this revolutionary packingless, self-priming centrifugal pump becomes even more useful because the new Type CG can handle flooded suction applications as well as the suction-lift conditions to which former Type G pumps were restricted.

Other advantages have been added, also, including closure of the dynamic seal to prevent escape of toxic gases, and the ability to flush the seal at will during normal operation.

Get the whole story in Bulletin G-1. Ask us to send your copy — today.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LaBOUR

THE LaBOUR COMPANY, INC. ★ Elkhart, Indiana, U.S.A.

▶ **One-Way Street**—In the electric membrane demineralizer electrolytic action moves ions through barrier membranes that isolate the water being demineralized. Water can not pass through the membranes. And the membranes prevent back-migration of the ions into the purified zone.

Each purification zone is bounded by two membranes—one cationic, the other anionic. The cationic membrane will pass only positive ions such as sodium, calcium and magnesium. Only negative ions of the chloride, sulfate and bicarbonate type will pass through the anion membrane.

The basic membrane mechanism is illustrated in the sketch, p. 246. In addition to the salt transfer reactions sodium hydroxide and hydrogen are produced at the cathode and chlorine gas at the anode. Neither of these reactions is effective in the demineralization.

▶ **Waste Stream**—In common with all known methods of demineralization the extracted minerals must be discharged in a strong salt solution. With the electric membrane unit, flow of this waste stream varies from 10 to 100% of the flow rate of the purified stream.

For the relatively small units now being offered the brine stream can be returned downstream in the original source, pumped into an underground formation already contaminated with salt or pumped to an evaporation pond or area of waste land.

▶ **Temperature Sensitive**—Units of this type are sensitive to relatively small temperature changes. For every degree above 70 F you can attain either a 1% increase in capacity or a 1% decrease in energy consumption. Thus, if feedwater were heated by waste heat to the upper safe operating limit of 120 F the energy consumption could be halved.

▶ **Present Models**—Packaged units are built in type B design, Series 300 through 2400; and type C design, Series 900 through 2400. Series number indicates the approximate capacity of the unit in gph. when removing 80% of the salt from a typical brackish water.

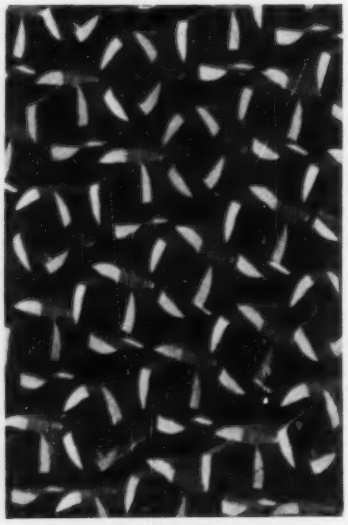
The B-type units have maximum flexibility for handling a wide range of input salinity, flow rate and product salinity. Without modification they can handle sea water at 35,000 ppm. or brackish water in the 1,000-5,000 ppm. range. However, they produce somewhat less water than C-type units and deliver product intermittently at intervals of 15 min. or more.

Where variations in the salinity of feed and desired product do not exceed 50-100%, the C-type unit is particularly adaptable. Without piping variations, it will tend to maintain a constant percentage removal of minerals, so that a change in feed salinity will cause a corresponding change in the product.

—Ionics, Inc., 152 Sixth St., Cambridge 42, Mass. 246A

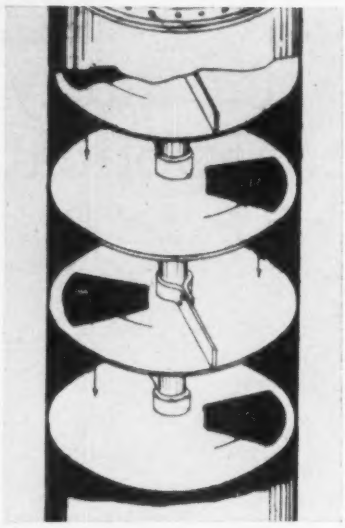
For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



What Is It?

A surrealistic necktie design? A street map of downtown Boston? A beehive gone wrong? Clue—These strange-looking hieroglyphs have an important function in a sulfur recovery process. Solution—See page 256. 248A



Contacting Column

For counter-current liquid-solid flow.

Designed to convert many batch operations into uniform continuous flow the A-C contact column is a total submergence, liquid-solid counter-current unit. It is adaptable to a wide variety of operations such as leaching of ore with water, acid or alkali; dissolving; decolorization; ion exchange molecular sieving; catalyzed reactions; absorption and oil extraction.

Flow of solids is regulated down the column by a series system of flow plates having rotating scraper arms. Each plate supports a quantity of solid material which is soaking in the liquid. Openings in the plates are arranged in staggered rotation.

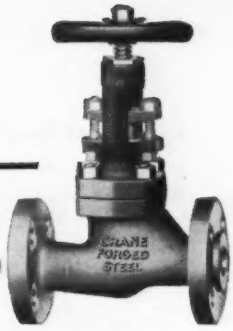
On individual plates as the scraper arm revolves it moves a slice of material from the bottom of the pile on the plate and discharges it through the opening. The solids settled through upflowing liquid coming to rest on top of the pile on the plate below.

Column diameters vary from 12 to 84 in. with solids throughput

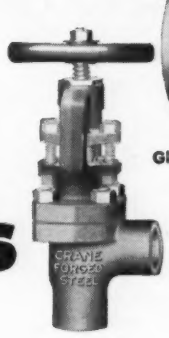
unmatched in dependability

CRANE

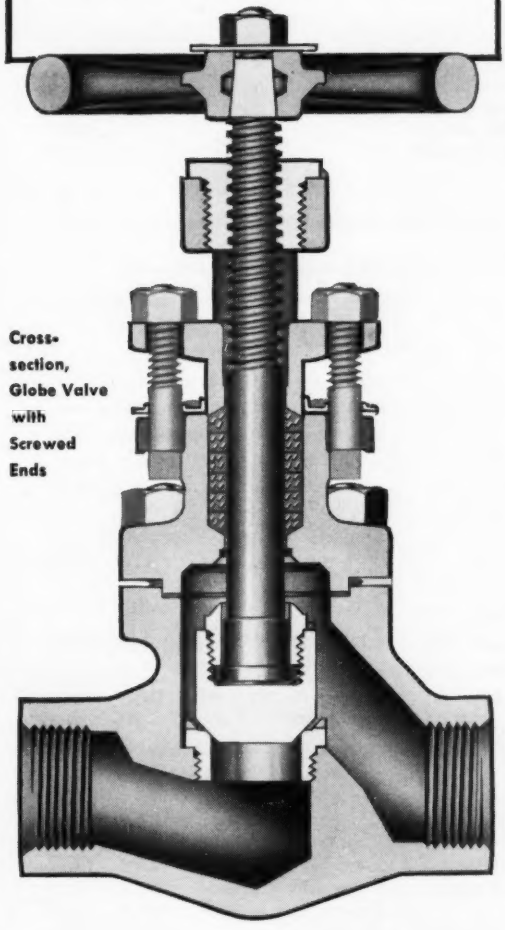
chlorine valves



Flanged Ends
Globe and Angle Patterns



Screwed Ends
Globe and Angle Patterns



Cross-section, Globe Valve with Screwed Ends

now regularly available with screwed ends *and* flanged ends

Take your choice of patterns in these Crane chlorine valves. They're *Crane Quality* throughout—designed exclusively for water-free chlorine gas or liquid up to 300° F.

In the cross-section you can see their strong, rugged construction—and the narrow bearing 45° taper disc and seat design that provides positive closure. Corrosion-resistant materials are used at all critical points. Disc, body seat ring and disc stem ring are durable Hastelloy "C." The stem and the gasket at the leak-proof bonnet joint are Monel. In the extra deep stuffing box there's laminated packing specially developed for chlorine service.

You're better equipped for chlorine control with Crane chlorine valves. Sizes ½ to 2-inch.

FULL FACTS are in new 4-page folder AD 1976. Write direct or ask your Crane Representative next time he calls.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

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Tube Ends....248A
Contacting Column....248B
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Tower Packing....250B

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Page number is also Reader Service code number

capacities up to 1,000 tons per day. Normally, there is a minimum of 20 plates spaced 12 in. apart. Retention time usually is adjusted for 30-45 min.—**Allis-Chalmers Mfg. Co., 1147 South 70th St., Milwaukee, Wis. 248B**

Demineralizer

With efficient mixed-bed ion exchange operates automatically.

Up to 200 gph. of high purity water is produced by the new MA-200 Mono-Column demineralizer. Furnished as a completely packaged unit, this exceptionally compact machine needs only be connected to the plant water system and the areas requiring high purity water.

Raw water is stripped of all its impurities by one pass through the column. A flow meter on the influent enables intake to be set at optimum rate for the most efficient ion exchange action. An electric purity meter plus automatic controls ensure purity of the effluent.

When effluent conductivity falls below standard, the effluent is bypassed to the sewer and warning given to signal need for regeneration. Throwing a single switch puts the unit through its regeneration cycle. Effluent cuts back in automatically when purity level is once more up to standard. The regenerative tanks fill automatically so that fresh acids and caustics may be added in preparation for the next regeneration cycle.—**Penfield Mfg. Co., Inc., 19 High School Ave., Meriden, Conn. 250A**

Tower Packing

Made of polyethylene claims 140% increase in efficiency.

There is a new operating twist for packed towers. With Tellerette packing, liquid is held up in interstitial spaces rather than on wetted surfaces. Result—efficiency is increased 140% over other equivalent size packings, reducing height of packed bed necessary for given separations.

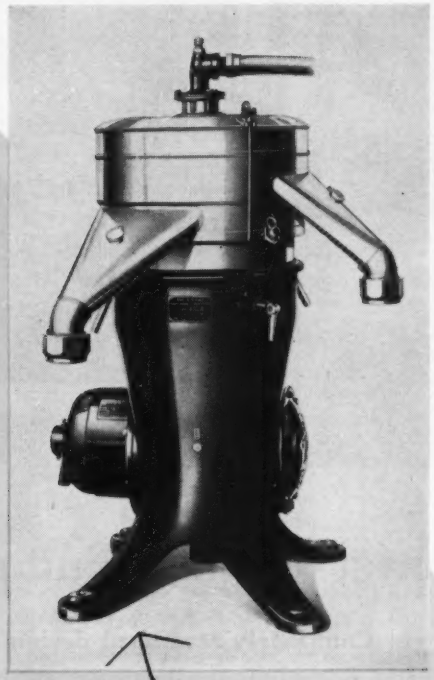
Tellerette packing is a polyethylene spiral bent into continuous circular form. Its light weight is only ¼ that of conventional packing. Compared to Raschig rings Tellerettes have three times the surface and 35% more free volume.—**The Harshaw Chemical Co., 1945 East 97th St., Cleveland 6, Ohio. 250B**

Equipment Cost Indexes

	March 1955	June 1955
Industry		
Avg. of all	186.2	188.1
Process Industries		
Cement mfg.	178.4	180.2
Chemical	187.1	189.0
Clay products	173.2	175.0
Glass mfg.	176.8	178.6
Paint mfg.	180.1	181.9
Paper mfg.	180.4	182.2
Petroleum ind.	183.7	185.6
Rubber ind.	186.1	188.0
Process ind. avg.	184.2	186.1
Related Industries		
Elec. power equip.	188.9	190.8
Mining, milling	188.0	189.9
Refrigerating	206.8	208.7
Steam power	176.3	178.1

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See *Chem. Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1955, pp. 178-9 for annual averages since 1913.

HOW MUCH TOO MUCH IS "STOP-AND-GO" COSTING YOU?



"Stop-and-go" separating by means of filters and settling tanks is costly, time-wasting . . . and *unnecessary*.

De Laval Centrifugals streamline production by making separation, clarification and concentration *continuous* processes.

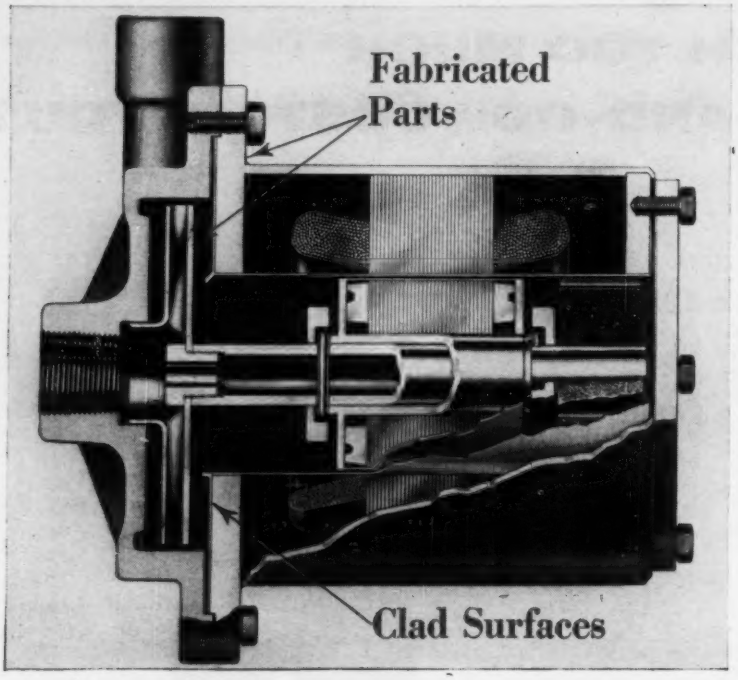
De Laval does in seconds what would otherwise take *minutes* or even *hours* . . . saves *time* . . . saves *money!*

What's equally important, in many processes De Laval Centrifugals also improve the product by doing a *more thorough* job of separation or clarification.

Let us show you exactly what De Laval Separators and Clarifiers can do for *you*.

DE LAVAL
for faster processing systems

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO. 201 E. Millbrae Ave., Millbrae, Calif.



Better Canned Pumps

Completely revamped design of leakproof pump extends potential applications, slashes price 20-25%, makes it competitive with mechanically sealed pumps.

Now, drawing on a 3-year backlog of operating experience, Chempump Corp. offers a new canned pump design that tumbles cost and broadens application potential. Not only is the price now competitive with mechanically sealed centrifugal pumps but the new construction is suitable for a wider range of services.

First new pumps off the production line are ½ and ¾ hp. sizes that deliver up to 53 gpm. at heads to 94 ft. for service to 350 F. and 150 psi. Larger integral units now undergoing test will be offered within a few months. These will be followed by units with double ends and others with plastic components.

► **Basically the Same**–In common with previous models the new SF pump has all rotating elements sealed within one enclosure. Pump impeller and motor rotor are mounted on a single shaft. System fluid circulates through the rotor-stator gap of the motor to remove heat. A non-magnetic metallic sleeve in the stator bore keeps system fluid from wetting the stator coils.

► **But Also Different**–Whereas, previous Chempump models have used many machined cast parts, the new SF design features fabricated construction that is simpler and costs less. For the SF model only the volute is cast. Other components are fabricated from plate or clad plate and welded into final form.

With such construction Chempumps now can handle a much wider range of corrosives. Supplementing previously available Monel, Carpenter 20 and various types of stainless steel is a choice of steel clad with titanium, zirconium, tantalum and the Hastelloys.

The next thing you'll notice about the new Chempump are the large Graphitar shaft bearings. Area of bearing surface has been boosted 400%. Semi-floating design provides a certain amount of self-alignment. These features are said to increase service life greatly.

Bearings can be removed for inspection or replacement without disconnecting piping connections. You unbolt the motor housing, remove the impeller, unbolt the housing cover plate and pull the rotor shaft. The outboard bearing comes with the shaft and you then can slip out the inboard bearing.

► **New Cooling System**–Stator windings, rotor and bearings are cooled and bearings are lubricated by a patented cooling and liquid circulation system. Liquid from the volute casing passes into the rotor chamber through passages around the outer periphery of the inboard bearing. Then it flows through the motor gap and similar passages in the outboard bearing, returning to the pump housing through the hollow rotor shaft.

► **Runs Fast**–In discussing the new pump Chempump officials point out that elimination of rotating shaft seals makes possible a standard operating speed of 3,450 rpm.

All sizes of the SF model will run at this speed. With fabricated impellers hydraulic unbalance is greatly reduced for smooth operation at this high rpm.

Chempump will continue to produce previous models including the line of UL approved units for Class I Group D locations, and the larger sized 5 and 7.5 hp. units.

Patents have been applied for on the new features embodied in the SF line and all patent rights are reserved–**Chempump Corp., 1300 East Mermaid Lane, Philadelphia 18, Pa.** **252A**

Bronze Valve

Has seat and disk that does not require replacement, renewing or regrinding.

Just unveiled publicly after a four-year testing program the new LQ600 bronze globe valve lays claim to unprecedented service life

IN CHEMICALS *(Soaps and Detergents)*

Count on Enjay for fast product turnover

You get fast turnover when you make a better product. And uniform, high quality Enjay chemicals help make *your* products better. The Enjay Company supplies a diversified line of petroleum chemicals to the surface coating, chemical and petroleum industries. Through the facilities of the *new Enjay Laboratories*, you can be assured of the best application of Enjay products in your industry. *Next* time, call Enjay for your chemical needs.

PETROLEUM
PARANOX
PARATONE
PARAFLOW
PARAPOID
PARADYNE
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PETROHOL
Methyl Ethyl Ketone
Dewaxing Aid
Ethyl Ether
Isopropyl Ether
Reference Fuels

RUBBER
ENJAY BUTYL
VISTANEX

SURFACE COATING
PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Secondary Butyl Alcohol
Secondary Butyl Acetate
Isopropyl Acetate
Acetone
Methyl Ethyl Ketone
Dicyclopentadiene
Ethyl Ether
Isopropyl Ether
Naphthenic Acids
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol

CHEMICAL
PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Tridecyl Alcohol
Dicyclopentadiene
Isoprene
Butadiene
Ethyl Ether
Isopropyl Ether
Tetrapropylene
Tripropylene
Aromatic Tars
Benzene
Acetone
Methyl Ethyl Ketone

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IN SURFACE COATINGS *(Paint, Varnish and Lacquer)*

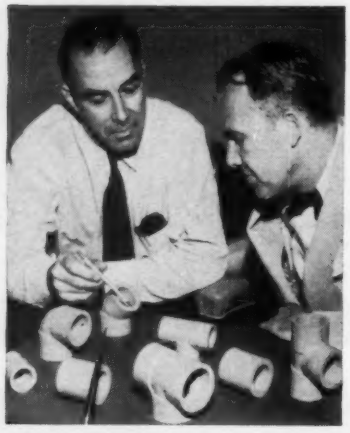
IN PETROLEUM *(Lubricants and Gasoline Additives)*

under the most difficult conditions. During the entire program conducted on "problem installations" at dozens of companies not one valve has failed or leaked, it is said. In many of these services other valves lasted an average of only three or four months.

A combination of two new elements make possible such outstanding performance: A new seating metal and a flat-seat design.

The new Brinalloy seating material is an alloy of nickel, chromium and silicon. It is hard all the way through; resists wear and corrosion even more than 500 Brinell stainless steel and far more than case-hardened stainless steel exceeding 1000 Brinell.

Flat-seat designs have long been considered impractical for throttling service because ordinary seating materials failed rapidly by wire-drawing. Brinalloy, however, is so resistant to wear and corrosion that it can be fused permanently into the valve for its entire service life.—**Lunkenheimer Co., Box 360, Cincinnati 14, Ohio. 252B**

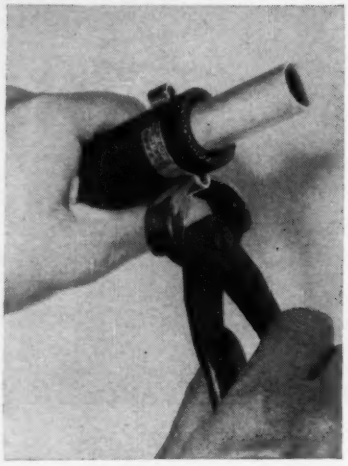


Pipe Fittings

Injection molded PVC for solvent welding.

The first injection-molded unplasticized-PVC solvent-welding pipe fittings are now available as a complimentary line to Tube Turns threaded fittings. They install rapidly and easily with a minimum of tools and equipment; are recommended for permanent lines.

Both threaded and solvent welding lines include 90 and 45 deg. elbows, tees, unions, couplings, caps, reducing bushings and flanges. **—Tube Turns Plastics, Inc., 224 East Broadway, Louisville, Ky. 254A**



Hose Clamp

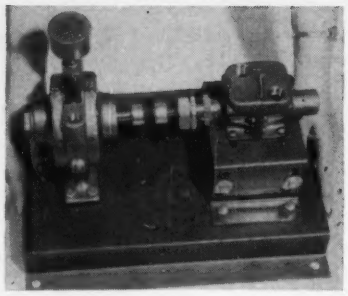
Can be applied within 3 sec., holds extreme pressure.

Using ordinary pincers, a new general purpose hose clamp can be attached in place within 3 sec. to give lasting and positive clamping action. Independent tests on ⅞-in wire-braided hose have shown no slippage or loss of clamping action at hose burst pressures in the 12,000 psi. range.

Clamp is round with U-shaped folds or lugs. Small clamps have two lugs; larger ones three. To use, you merely slip the clamp on the hose or part and crimp in place by squeezing the parallel sides of the lug together with pincers. To remove, you simply snip off the lugs with the pincers.—**Circle Pump Co., 39 Broadway, New York 6, N. Y. 254B**

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



Pump Unit

For hazardous materials is driven by air motor.

Now available for pumping corrosive and hazardous materials is a new combination of an Eco positive displacement, stainless-steel pump driven by an air motor. Pumping speed is controlled closely by a single manual adjustment. On non-volatile fluids unit is completely self-priming.

Air motor will operate on compressed air supply varying from 40 to 100 psi. Reversible air motors are available where pump must be used for charging and subsequent evacuation.

The pump has a chemically inert, mechanical seal. There is a choice of alloys and non-metallic rotors, as well as the new Teflon-ceramic shaft seal. Unit will handle up to 10 gpm. at pressures to 100 psi. **—Eco Engineering Co., 12 New York Ave., Newark, N. J. 254C**

Centrifugal compressor line newly announced ranges in size from 500 to 65,000 cfm. Expected to augment manufacturers established line of reciprocating compressors serving transmission lines, refineries and petrochemical plants.—**The Cooper-Bessemer Corp., Mt. Vernon, Ohio. 254D**

Drum faucet fabricated from polyethylene is cheaper, more durable and lighter weight than regular metal faucets. Operates smoothly and will not leak, regardless of temperature or type of material with which it is used, it is claimed.—**Multi-Meter Corp. Box 154, West Toledo Station, Toledo 12, Ohio. 254E**

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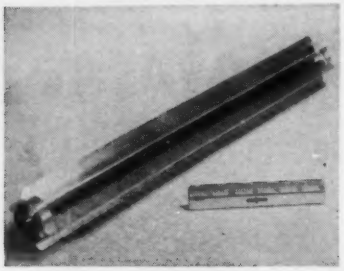


Fuel of the Future

For atomic reactors, recently declassified.

This unclassified atomic fuel was shown to the public for the first time recently. Built for the research reactor at the Brookhaven National Laboratory the fuel element has three aluminum-clad fins approximately 30 in. long held together at the ends by aluminum rings approximately 2½ in. in dia. Inside the aluminum cladding or covering is a thin layer of uranium-aluminum mix. When a sufficient number of these fuel elements are placed in an atomic reactor under the right control conditions atomic fission takes place.—**Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.** 256A

Coke-Burning Furnace

Adapted to use of low-volatile petroleum coke.

A new development in furnace design makes possible utilization of increasing supplies of petroleum coke brought about by the fluidized coking process. Through modification of the Cyclone furnace, burning difficulties stemming from low volatility and grindability of petroleum coke have been overcome.

Operating with a modified design, combustion rates have been as high as 800,000 Btu. per hr. per cu. ft. of furnace with fuels having a volatile content of 4-7%. Supplemental ash is added to wet the furnace walls in order that coke particles will stick until combustion is completed. High sulfur and vanadium content in the coke is overcome by using additives.—**Babcock & Wilcox, 161 East 42nd St., New York, N. Y.** 256B

Stainless Exchangers

Available in standard sizes from stock.

A new line of stainless-steel heat exchangers is designed for heating and cooling corrosive liquids or gases. These type SSF units meet J.I.C. Standards for the Hydraulic Industry.

Exchangers are designed to eliminate strains due to radical temperature difference. Smooth flow end bonnets provide least possible impact on tubes and tube sheets at the inlet to the tube bundle.

Other features include 20% segmented baffles, spaced for maximum heat transfer with minimum drop in pressure. Heat resistant gasket eliminates by-passing and prevents leakage. Clearance between baffles and tubes, baffles and shell are held to a minimum resulting in maximum exchanger efficiency.

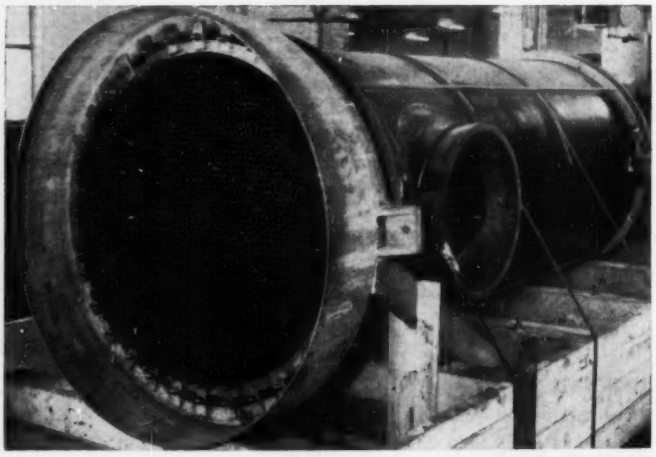
A large range of sizes and capacities are available for users of these single and multi-pass fixed-tube-bundle standard heat exchangers.—**Young Radiator Co., Racine, Wis.** 256C

Rotary Joint

Seals at low pressure up to 550 F.

Redesign of a low pressure rotary joint enables it to seal perfectly up to 550 F. A balanced-piston design gives line contact at the rotating seal surfaces to assure long life.

A standard low-pressure joint was adapted to satisfy high temperature needs by redesigning the piston, and piston seal. A formed shape of Rulon patented low-friction bearing material is fitted to the new piston and maintained under pressure by the sealing spring and line pressure. There is self-adjusting take-up for wear.—**Anco Div., American Associates, Inc., One Baker St., Providence 5, R. I.** 256D



Puzzle Unravels When Placed in Proper Perspective

What you saw on page 248 were some of the 685 tangentially notched weirs on the tube ends of this large Karbate-brand impervious-graphite shell-and-tube heat exchanger. Weirs distribute a falling film of cooling water within each of the 9-ft. long tubes of 2,000 sq. ft. unit. Operated vertically as one of a pair, exchanger cools SO_2 from the combustion of refinery sludge acid, is one of the largest impervious-graphite shell-and-tube units ever constructed at National Carbon's Cleveland plant.—National Carbon Co., Div. of Union Carbide & Carbon Corp., 30 East 42nd St., New York 17, N. Y. 256E

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CHEMICAL ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

NO. 7 — 1955

Du Pont ALATHON® helps solve piping and packaging problems in chemical industries

Du Pont "Alathon" polyethylene resin is inert to many chemicals used in industry. Hydrochloric, sulfuric and hydrofluoric acids, in concentrated solutions, can be shipped or stored in carboys or bottles of "Alathon."

"Alathon" is odorless, tasteless and non-toxic. It has a low water-vapor transmission rate. "Alathon" is tough and flexible over a wide temperature range. In some cases, "Alathon" retains its form unstressed in boiling water. "Alathon," with a specific gravity of 0.92, is one of the lightest plastic resins commercially available today.

Combination of Properties

Because of an unusual combination of properties—high chemical resistance, toughness and flexibility through a wide temperature range—"Alathon" presents possibilities for applications in many industrial fields. Among the important industrial uses for "Alathon" are pipe and fittings for water and chemical process lines.

Du Pont "Alathon" polyethylene resin is used as packaging material in such forms as film, bottles, closures, liners for fiber and metal drums, and carboys.

Molded or Machined

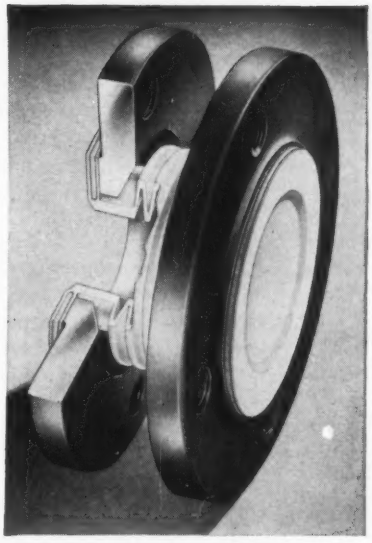
Du Pont "Alathon" polyethylene resin can be injection- or compression-molded and extruded. Parts made of "Alathon" polyethylene resin are easily machined with standard tools used in working soft metals. These parts can be joined by heat welding. Chemically resistant Du Pont "Alathon" may help you develop a new product or process, or improve your present one. For further information on this versatile engineering material, use the coupon.

Flexible Bellows of TEFLON® Assures Maximum Service Life

Where applications are toughest in the chemical processing industry, parts of Du Pont "Teflon" tetrafluoroethylene resin assure dependable operation. For "Teflon" is not attacked by any chemicals normally encountered—only molten alkali metals, and fluorine at elevated temperatures and pressures affect "Teflon." And, conversely, "Teflon" will not contaminate the products in contact with it.

Operating temperature range is from —450°F. to 500°F. This wide range, coupled with the chemical inertness of "Teflon," provides new opportunities for designers of process equipment.

Consider the flexible bellows of Du Pont "Teflon" tetrafluoroethylene resin fabricated by Crane Packing Company of Chicago, Illinois. These bellows are designed for heavy-duty applications—as vibration dampeners, expansion joints, flexible connectors—and the manufacturer reports that French gasket-type flanges assure maximum sealing efficiency. Crane Packing Company has developed a new convolution form, they report, which assures great strength, long service life and maximum flexibility. The bellows are formed at full free length, to hold residual and working strain at a minimum.



Flexible bellows and companion flanges, manufactured by the Crane Packing Company, Chicago, Illinois. Du Pont "Teflon" tetrafluoroethylene resin, inert to all industrial chemicals, has a working temperature range of —450°F. to 500°F.

Investigate "Teflon." No other single material provides the unique combination of properties offered by "Teflon" tetrafluoroethylene resin. For complete property data, clip the coupon below.

NEED MORE INFORMATION?

CLIP THE COUPON for additional data on the properties and applications of these Du Pont engineering materials.

**"Teflon," "Alathon," "Zytel" and "Lucite" are registered trade-marks of E. I. du Pont de Nemours & Co. (Inc.).*

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 1259, Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited,
P.O. Box 660, Montreal, Quebec.

Please send me more information on the Du Pont engineering materials checked: ☐ "Teflon"* tetrafluoroethylene resin; ☐ "Alathon"* polyethylene resin; ☐ "Zytel"* nylon resin; ☐ "Lucite"* acrylic resin. I am interested in evaluating these materials for_____

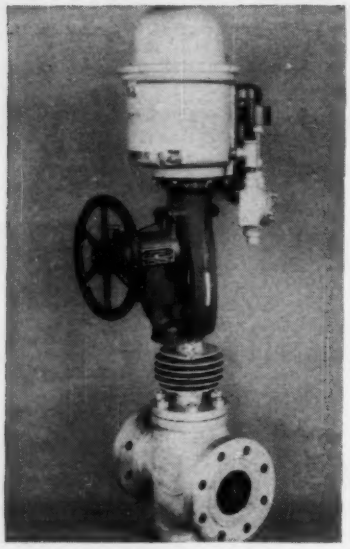
NAME_____

COMPANY_____ POSITION_____

STREET_____

CITY_____ STATE_____

TYPE OF BUSINESS_____



Valve Operator

Is self contained, runs without air supply.

A new self-contained Electro-Hydraulic operator for valves controlling variables such as pressure, temperature and flow operates without a supply of compressed air. Operating entirely by electric power it overcomes the problem encountered in long distance transmission, freezing or clogging of pneumatic tubing and high cost of air supply.

Unit is designed to position conventional slip-stem control valves. An electrically driven pumping unit develops hydraulic pressure to operate the valve.

Operator may receive proportioning, reset and rate action signals from the American-Microsen transmission and control system to control, ratio, program, etc. Positioning accuracy is established by a self-contained feedback system.—**Manning, Maxwell & Moore, Inc., Industrial Controls Div., Stratford, Conn.** **258A**

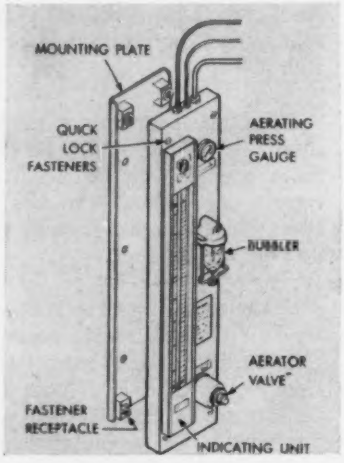
Temperature Control

Gives control point accuracy equivalent to individually calibrated units.

Design of the new E32N indicating temperature control provides a calibrating mechanism to compensate for movement errors of commercial thermal systems. Where the E32N is used such systems can be replaced in the field without loss of initial calibration accuracy.

Each instrument is automatically compensated for ambient and overtravel temperatures to maintain the control point at its calibration accuracy under all conditions. Simple, rugged construction is said to give dependable performance at lower cost than comparable temperature control instruments.

Twelve standard models offer range spans from 300 to 550 F between limits of −150 to +650 F. Approximate on-off differential is 0.5 F. Rated for 15 amp., 115/230 v. a.c.—**United Electric Controls Co., 85 School St., Watertown 72, Mass.** **258B**



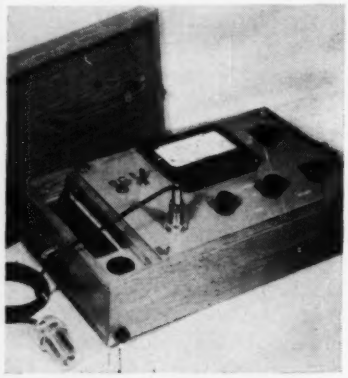
Tank Gages

Operated by hydrostatic pressure.

The new Series 1400 Petrometer remote-reading liquid-depth gages can be installed rapidly and conveniently on tanks up to 50 ft. deep either above or below ground. Depth of liquid is indicated accurately on panel located anywhere within ¼ mile from the point of measurement.

Hydrostatic pressure exerted by the liquid head in the tank is transmitted pneumatically through a copper tube to the liquid column in the indicator.

Instrument has a self-contained panel with all functional parts included on the panel. Indicating liquid is sealed-in to prevent spillage and eliminate cumbersome filling through small openings. All four models have a push-button aerator valve to purge transmission line.—**Liquidepth Indicators, Inc., 43-22 Tenth St., Long Island City 1, N. Y.** **258C**



Thermistor Radiometer

Measures surface temperatures directly from a distance.

If you use the Williamson Radiometer you don't need to make contact with a hot surface in order to determine its temperature. Readings can be taken from a distance merely by directing the radiometer at the desired object. It's suitable for measuring temperature of operating equipment, building walls and liquids.

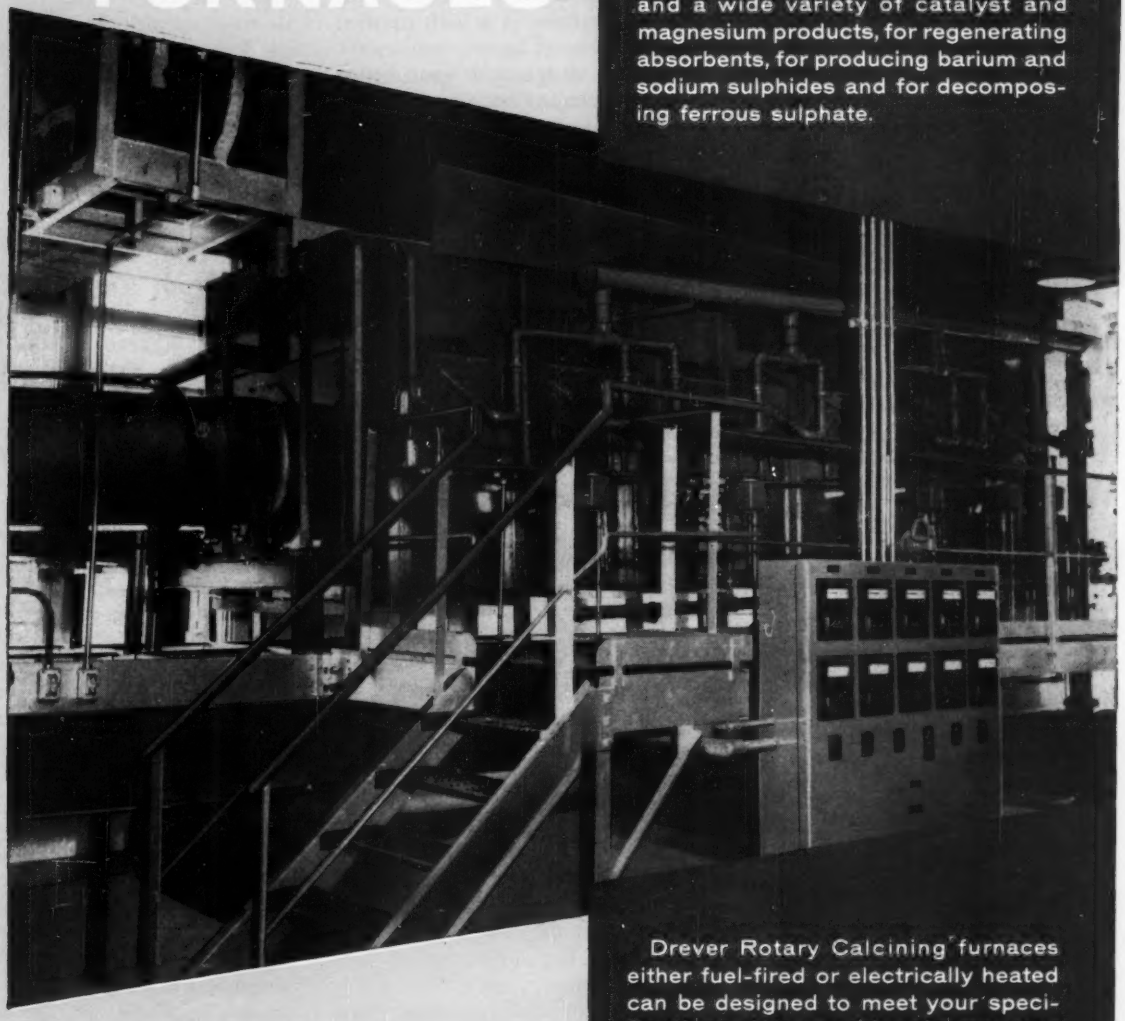
Instrument has a temperature-detecting head, an amplification circuit and a reference black body for temperature calibration. Radiant energy is collected through a conical aperture in the head and detected by four thermistors in a Wheatstone bridge within. A flexible cable carries information from the head unit to the amplifying circuit. Temperatures are indicated on a microammeter.

Surfaces can be scanned quickly to measure temperature differences as small as 0.1 C. The metering circuits provide full scale readings of 10, 30 and 100 deg. C.—**Williamson Development Co., 317 Main St., West Concord, Mass.** **258D**

DREVER Rotary CALCINING FURNACES

Here illustrated is one of a group of four gas-fired calcining furnaces which is used to dry special catalytic material after pelletalizing.

Furnaces of this type find wide application in such operations as calcining lithopone and titanium pigments and a wide variety of catalyst and magnesium products, for regenerating absorbents, for producing barium and sodium sulphides and for decomposing ferrous sulphate.



Drever Rotary Calcining furnaces either fuel-fired or electrically heated can be designed to meet your specifications. We would welcome your inquiry involving specialized calcining and drying operations.

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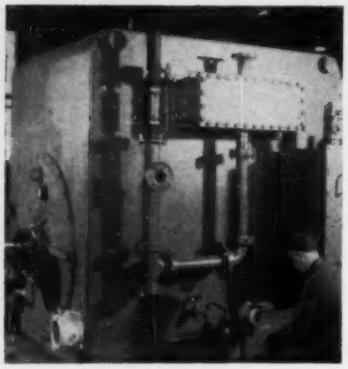


Gas-Filled Motor

For safe operation in hazardous areas.

Available in a wide range of ratings a new line of inert gas-filled motors provide safe operation in hazardous gas-contaminated areas. They are currently being supplied to refineries to drive high-speed centrifugal compressors.

Under positive pressure, the nonexplosive gas inside the motor keeps out volatile ambient gases that could cause an explosion. Air-to-water surface heat exchangers remove motor heat. Gas-tight welds and seals on shaft extensions keep leakage of the inert gas at a minimum. A gas pressurizing manifold maintains positive pressure within the housing.–**Allis-Chalmers Mfg. Co., General Machinery Div., Milwaukee 1, Wis.** 260A

Mechanical Seal

Furnished completely assembled ready to install.

Just announced for use on rotary shafts is the BB-21A Mechanipak seal for pressures up to 150 psi. These mechanical seals are said to save money by eliminating wear on shafts and shaft sleeves, stopping fluid leakage, reducing down time and cutting maintenance costs.

Standard construction for operating temperatures up to 212 F and pressures up to 150 psi. includes brass shell, brass washer and Buna-N or neoprene bellows. Silicone bellows are provided for temperatures up to 400 F where pressures do not exceed 50 psi.

Seals are available for shafts from $\frac{3}{8}$ to 3 in. dia.–**Garlock Packing Co., Palmyra, N. Y.** 260B

Speed Reducers

With simple, compact design and outstanding durability.

For speed reduction needs the new Line-O-Power reducer offers easy maintenance, dependable performance and an unusually long life expectancy even with constant usage.

Gear design and construction provides higher capacities in a compact unit. Input and output shafts are in a direct line to permit motor and speed reducer to be coupled in less space.

Exclusive "Spline Drive" pinion makes it easy for the user to change reduction ratios. The range of nominal ratios for double, triple and quadruple reductions is from 5.06 to 1,478.–**Foote Bros. Gear & Machine Corp., 4545 South Western Blvd., Chicago, Ill.** 260C

Welding Process

Boosts rate of metal deposit, cuts cost.

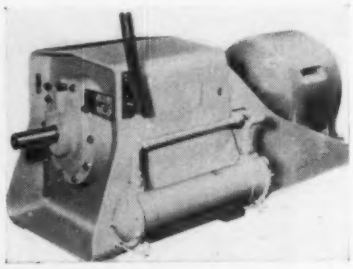
An eye-popping five-fold gain in deposit rate of weld metal at half the power cost is posted for a new automatic submerged-arc welding process. Cost of the entire system is expected to run no higher than for present automatic welding.

What makes the new system unique is the use of resistance to preheat the electrode almost to its melting point before it enters the arc. Practically all the energy absorbed by the electrode at the arc supplies heat of fusion to melt the metal.

Deposit rates have been found inversely proportional to wire size for a given current. Also, at high current density deposit rate is directly proportional to the length of the electrode wire from the contact shoe to the arc.

Energy to heat the electrode to the melting point is measured in terms of the square of the current (I^2), the resistant (R) of the electrode wire projecting from the contact nozzle to the arc, and the time (T) that the current flows through any given cross section of the wire. From these terms is derived the designation I^2RT method.

Current densities are so high (70,000 to 270,000 amp. per sq. in. vs. 10,000 to 20,000 amp per sq. in. for other methods) that only submerged-arc and inert-gas welding can be used. A special guiding device keeps the weld head and arc trued up with the work. Beads are deposited too fast for accurate manual guiding.–**Babcock & Wilcox, 161 East 42nd St., New York 17, N. Y.** 260D



Fluid Drive

For no-load starting and torque-limiting control.

A new line of enclosed, completely self-contained fluid drives transmit power smoothly through a stepless speed control. Speed is adjustable over a wide range on both variable and constant torque loads with this type VS, Class 2 Gyrol fluid drive.

Units are designed for dual rotation. Fluid drive and load can be reversed while in motion merely by reversing input rotation when used with an electric motor.

With the new Gyrol fluid drive the motor can come up to speed under practically no-load conditions. In many cases across-the-line starting is practical. The drive will limit the amount of overload torque transmitted to load.

Drive is readily adaptable to manual or fully automatic control. It is available in six sizes from 7.5 to 800 hp. for operating speeds up to 1,800 rpm.–**American Blower Corp., Detroit 32, Mich.** 260E

WAUKESHA has the know-how to cast CORROSION-RESISTANT CASTINGS

for many industries

to help solve your tough product design problems

• **Why Waukesha—Broad Foundry Know-How and Successful Accomplishment** are at your disposal. An **Analytical Approach** to every casting problem contributes significantly to the right solution to your design problem. **Active Metallurgical Research** guarantees castings that are a valuable functional and sales asset to your products. **Corrosion-Resistant Metals,** whether of stainless steel or "Waukesha Metal" (a nickel alloy), are created to fit the precise corrosion-resistant needs of your castings. **Complete Facilities** are available to you . . . from engineering design counsel to the finished casting; and with delivery geared to your production schedule.

Why not rely on Waukesha to provide you with quality corrosion-resistant castings. **We suggest you write for a casting quotation or for engineering counsel.** Informative literature and corrosion-resistant information are available. Waukesha Foundry Company, 5501 Lincoln Avenue, Waukesha, Wisconsin.

CHEMICAL

Pump housing used in a chemical plant.

PETROLEUM

Valve body for petroleum industry.

DAIRY

Pump housing for dairy equipment.

FOOD

Screen frame for a juice extractor.

PAPER MILL

Casting for paper mill machine.

INDUSTRIAL

Filler bowl used in a plant.

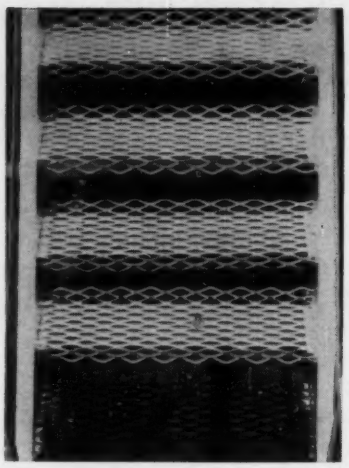
Above are typical Waukesha corrosion-resistant castings from created metals that solved product design problems.

Waukesha takes pride in its precise quality control standards and procedures.

Waukesha Foundry Company

WAUKESHA, WISCONSIN

WAUKESHA: *SPECIALISTS IN CORROSION-RESISTANT CASTINGS FOR ALL INDUSTRIES*



Plant Gratings

Made of expanded metal cut cost 30%.

Direct from Florida comes a report on use of expanded metal flooring and stair treads in the new phosphate recovery plant of Armour and Co., near Bartow. In addition to the usual advantages of open-type flooring this installation is estimated to have cost 30% less than bar-type treads of similar strength.

On stairs, each tread is a single piece of 4.27 lb. expanded metal turned over 90 deg. at the front and rear edges. This forms a kick plate and strengthens the tread. A 1¼ x 1¼ in. angle is welded to the mesh at either end to form a fastening plate. Most of the treads in this plant are 36 in. long and will support a 200 lb. man at mid span without apparent deflection.—**Penn Metal Co., Inc., 205 East 42nd St., New York 17, N. Y.** **262A**

Aluminum Tubing

For corrosive conditions, in many shapes.

New high-strength aluminum specialty tubing of 6066 Harvey alloy is highly resistant to general corrosive conditions found on many jobs. Made in a range of shapes and sizes it has good weldability and surface finish.

In addition to the conventional round form it is made in square, rectangular and special configurations. Recommended uses include water heaters, gas engines, refrigerators, condensers, unit heaters, air line pumps and water lines. Also, it has structural possibilities in scaffolds, rails, booms, towers, etc. —**Harvey Aluminum, 19200 South Western Ave., Torrance, Calif.** **262B**

Vapor Barrier

Foil-film laminate produces combination of desirable properties.

By laminating a one-mil sheet of aluminum foil between two half-mil sheets of Mylar polyester film one manufacturer has brought forth a unique vapor barrier. It combines the moisture impermeability of aluminum foil with the flexibility, strength, toughness and durability that are built into polyester film.

As a barrier to moisture vapor the laminate virtually eliminates condensation problems. On pipe insulation it provides moisture vapor-proof protection under exposure to salt air, corrosive fumes, oils and acids. And because it can be applied as easily as wallpaper it's fine for lining floors, walls and ceilings to control extreme humidity conditions.

Zero Perm laminate can be sealed with MEK adhesive or heat sealed after the adhesive has been applied.—**Alumiseal Corp., 385 Madison Ave., New York 17, N. Y.** **262C**

Pipe Wrapping

Formulated exclusively to prevent pipeline corrosion in many environments.

Increased adhesion and conformability even at freezing temperatures are claimed for a new all-weather, polyvinyl-chloride, pipe-wrap tape. It's the first pressure-sensitive, polyvinyl-chloride tape formulated exclusively to prevent pipeline corrosion.

Both surface and underground piping can be protected to advantage in pipelines, tank farms, chemical works, gas and water mains, and service lines. It is recommended for all small diameter pipe; for wrapping sections of uncoated pipe—both new and reconditioned; for resealing or repair jobs; and, for wrapping joints or couplings on mill-wrapped pipe.

Two tapes available are: Scotchrap No. 50, 10 mils thick, for fittings; and no. 51, 20 mils thick, for straight-run wrapping. Rolls come 100 ft. long in 1, 2, 6, 8, and 12 in. widths.—**Minnesota Mining & Mfg. Co., 900 Fauquier St., St. Paul 6, Minn.** **262D**

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

high quality product

boost average ratings as much as 2 octane numbers with the

Ljungstrom® Air Preheater

With waste heat recovered and returned to the furnace in combustion air, the most modern heat-transfer systems can be operated at peak efficiency.

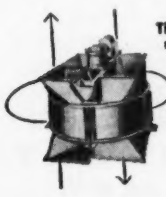
That's why you boost product quality with the Ljungstrom Air Preheater. It's heat-recovery efficiency makes possible advanced furnace designs that assure remarkably close control of processing. And finer control means a more uniform product . . . with average ratings as much as 2 octane numbers higher. One still's added income just from higher product quality is $58,000 annually.

HOW FAST IS "WRITE-OFF"?

In earnings from higher octane ratings, many refiners write off the cost of the Ljungstrom installation in less than two years. This time is cut to *nine months and even less*, when the other Ljungstrom advantages are taken into account — saves up to 20% in fuel costs . . . permits more economical furnace design, with no need for convection surfaces . . . burns many fuels you used to throw away . . . results in consistently higher through-put . . . and minimizes slag.

For more complete details on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits obtainable in fuel burning equipment — call or write The Air Preheater Corporation.

Wherever You Burn Fuel, You Need Ljungstrom

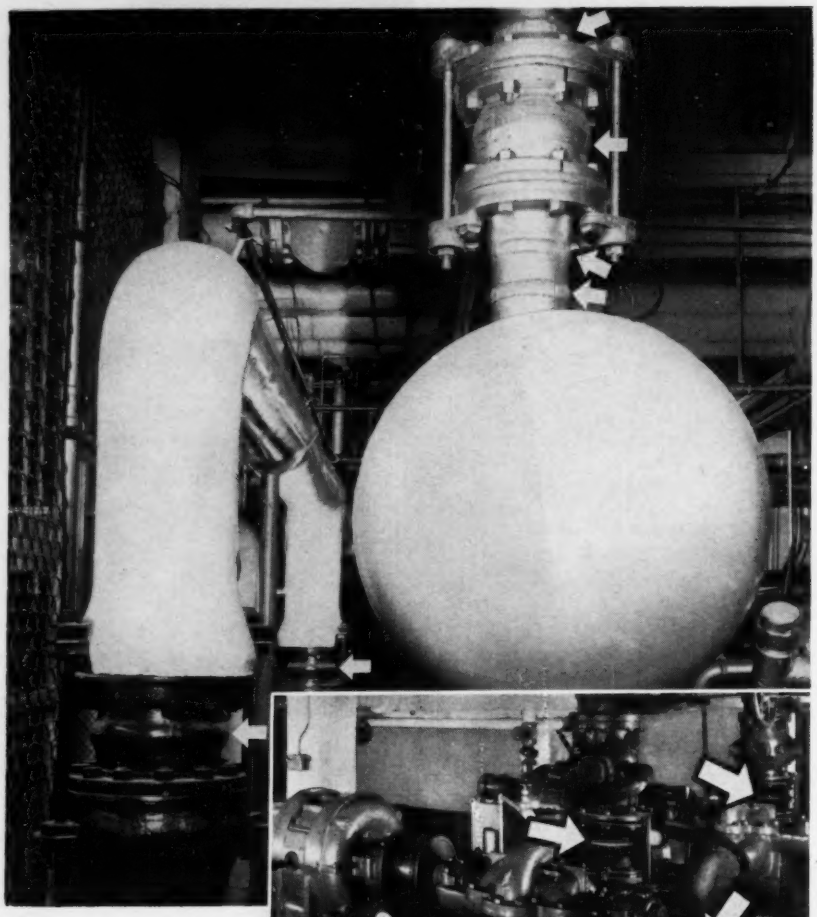


The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transfered from the waste gases to the incoming cold air.

The Air Preheater Corporation **60 East 42nd Street, New York 17, N. Y.**

FOR SILENT, VIBRATION-FREE AIR-CONDITIONING SYSTEMS

Prevent transmission of compressor noises in circulating lines with U. S. Rubber Expansion Joints



A compressor with expansion joints on the suction and discharge lines. Suction line is at bottom, discharge line at top. Expansion joints were vulcanized to welded flanges at our factory, to handle Freon in the compressors.

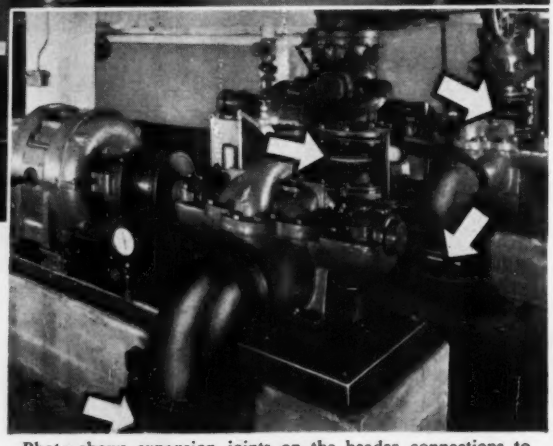


Photo shows expansion joints on the header connections to the condenser and to the cooler and on pipe lines at the circulating water pump.

These flexible rubber connections for pressure and vacuum pipe lines insulate against vibration and prevent the transmission of noise. They also offset stresses caused by expansion and contraction and misalignment. You will find U. S. Expansion Joints are standard on many of the most up-to-date air-conditioning installations.

A product of United States Rubber Company, these U. S. Expansion Joints have many applications in air conditioning: they are used for the chilled-water lines from the water chillers, and the refrigerant lines from the refrigerating compressors; also the water lines to and from the cooling towers. They are used on the header connections to the condenser and to the cooler and on pipe lines at the circulating water pump.

For handling Freon in compressors, there is a specially-designed U. S. Freon Expansion Joint.

Since they have no moving parts to wear or bind, U. S. Expansion Joints last a long time. Some are still in service after 30 years—a record unmatched by any other expansion joint! U. S. Expansion Joints will solve any pipe line problem caused by noise, vibration and misalignment. They are obtainable at any of the 27 "U. S." District Sales Offices, or write address below.

"U. S." Research perfects it..."U. S." Production builds it...U. S. Industry depends on it.

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

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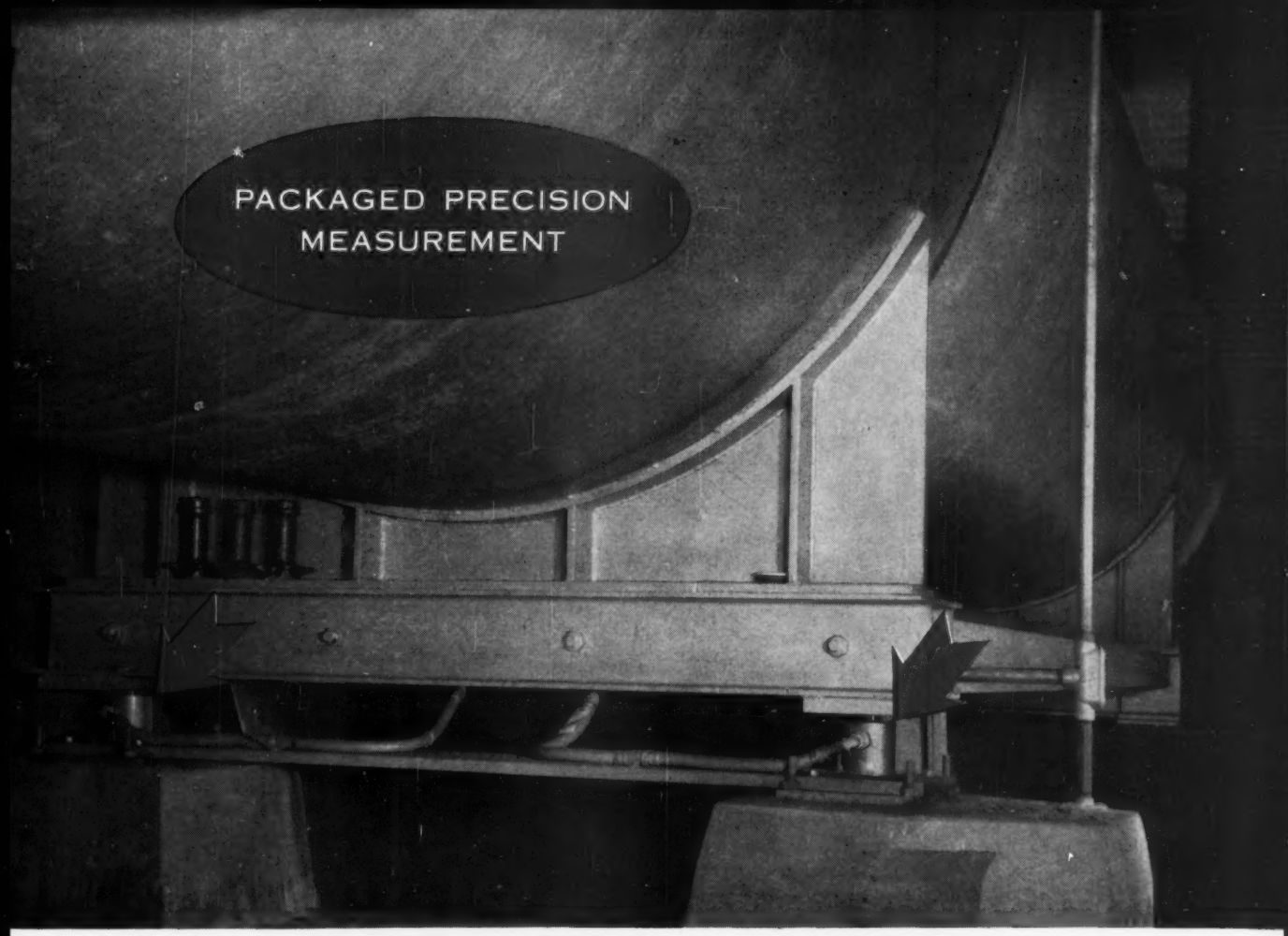


Stanley Home Products, Inc. checks Freon losses as

Two tiny SR-4® Load Cells weigh 200,000 lb. tanks automatically

Baldwin's "Packaged Precision Measurement," neatly solved the handling of large volumes of Freon at the Stanley Home Products plant in Easthampton, Mass. A constant record of stored and used quantities was needed to avoid excessive leakage and evaporation losses.

Continuous automatic weighing of their two 15,000 gallon storage tanks with Baldwin SR-4 Load Cells answered Stanley's problem perfectly. Two small SR-4 compression-type 50,000 lb. load cells were installed as supporting members on the concrete base at one end of each tank. These support exactly half the load of the 200,000 lb. tanks and the instruments are calibrated to read only the weight of the Freon in the storage tanks.

Reinforced flexible hose at inlet and outlet eliminates effect of connecting piping on weighing accuracy.

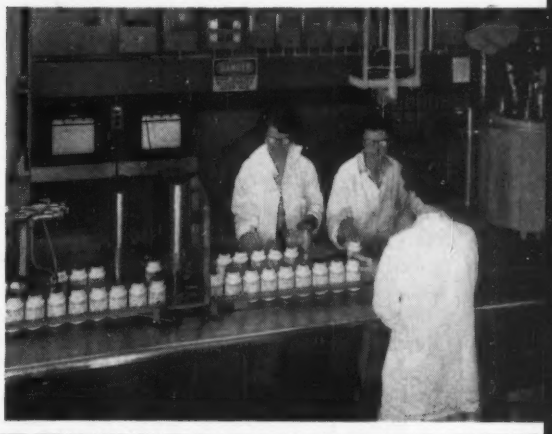
This Baldwin system gives Stanley weighing accuracy within ½ of 1% of scale (200,000 lbs.). Baldwin-engineered instrumentation provides remote indicators at the tank car siding and recorders at a centralized control panel. The weighing system controls a motor-driven pump at the siding, shutting it down automatically when the tanks have 13,500 gallons of Freon.

Packaged Precision Measurement can solve similar problems for *you*. For detailed information on SR-4 Device applications and instrumentation use coupon today.

Eddystone Division

BALDWIN-LIMA-HAMILTON

Baldwin strip chart recorders on wall (lower photo) show rate of consumption of Freon. Recorders are connected by electrical cables to SR-4 Load Cells under one end of 15,000 gallon tanks on other side of wall (upper photo).



Dept. 3304
Baldwin-Lima-Hamilton Corp.
Philadelphia 42, Pa.
(In Canada: Peacock Bros., Ltd., Montreal, Quebec)

Please send me the following new literature

- ☐ Bulletin 4300 (Introduction to SR-4 Devices)
- ☐ Bulletin 4301 (SR-4 Load Cells and Load Beams)
- ☐ Bulletin 4302 (SR-4 weighing of tanks, bins, hoppers)
- ☐ Bulletin 4306 (SR-4 Fluid Pressure Cells)

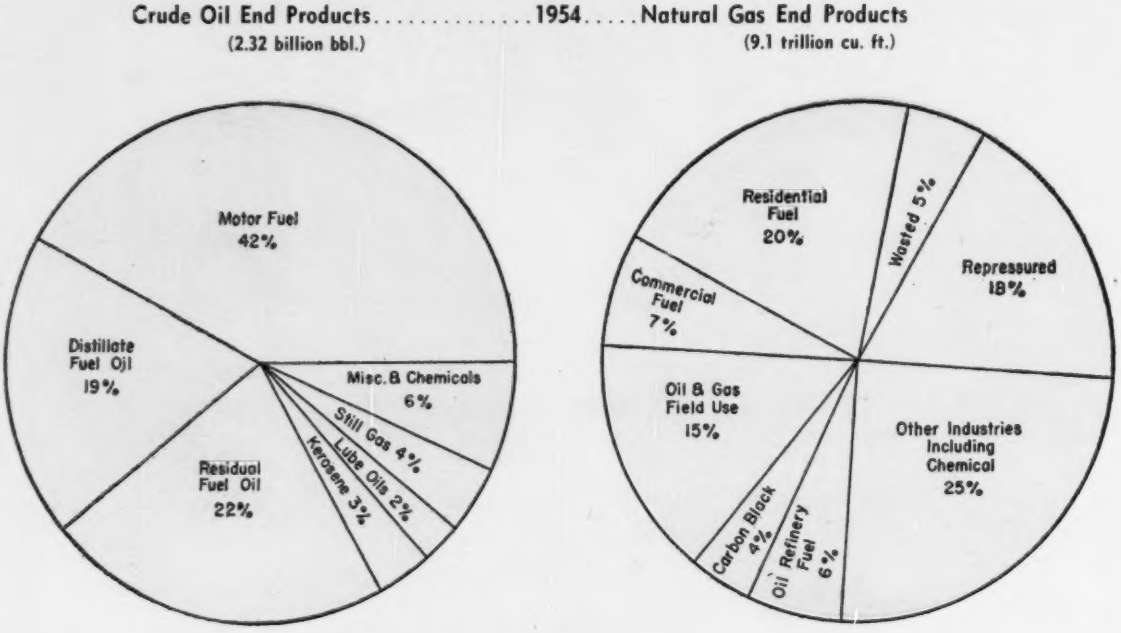
Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

Petrochemicals: A Small Part of Total Oil Output



Petrochemicals Flourish, No Limit Seen

Here's the first of three fact-packed articles on petrochemicals. How healthy is the industry today? Who makes what, where, how much? Where are they used?

C. J. Matthew, R. F. Messing and R. L. James, Arthur D. Little, Inc.

While some people feel that the term "petrochemical" has been overly glamorized and popularized, one can't help but be mightily impressed by the tremendous growth of that industry during the past 15 years.

Output has increased from about 4 billion lb. in 1940 to about 25 billion lb. in 1954. Assuming an average value of 12¢/lb. for these products, this represents an industry with sales of about $3 billion per year.

Before going further we should pause to consider more specifically the products included in the petrochemicals group. Petrochemicals may be defined as chemical products that are derived primarily from petroleum and natural gas. There are four basic hydrocarbon types available in petroleum and natural gas. They are: paraffins, including methane, ethane, propane and butane; olefins, such as ethylene, propylene and butylene; naphthenes, including cyclopentane and cyclohexane; and finally, aromatics, typified by ring structures: benzene, toluene and xylene.

CHRIS MATTHEW is *West Coast Manager of Arthur D. Little, Inc., located in San Francisco.* ROBERT JAMES *and* DICK MESSING *are in the firm's Industrial Economics Dept. in Cambridge, Mass.*

Where the Series Stands

I. Growth, Methane & Derivatives
II. Ethane, Ethylene & Derivatives
III. Propane, Butane & Derivatives, plus Higher Hydrocarbons

To give you a comprehensive roundup on individual petrochemicals, we're splitting this report into three parts. This month we review the general health of the industry and itemize developments in methane and its derivatives. Watch for ethane, ethylene and derivatives in October and the higher hydrocarbons in November.

► **Basically Chemical**—It's worth noting that chemical companies account for by far the largest share of the petrochemical business and undoubtedly will continue to domi-

FOR CONDENSER AND HEAT EXCHANGER TUBES AND PLATES SPECIFY

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CUPRO-NICKEL—30%, 10%
ADMIRALTY METAL
ARSENICAL COPPER
ALUMINUM BRONZE—5%
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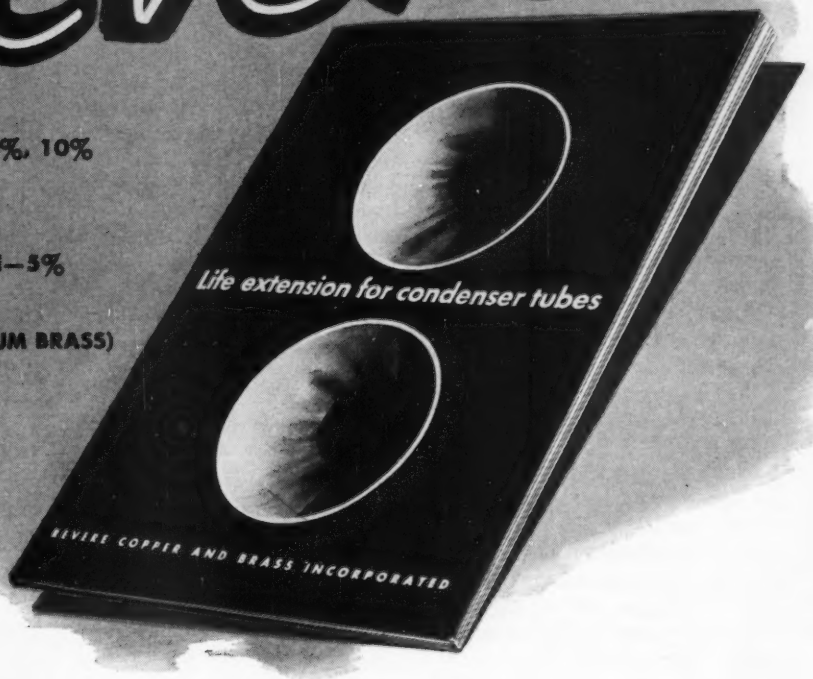

• Correct selection is essential if tubes and plates are to serve with the maximum economy and minimum trouble. The Revere Technical Advisory Service and Revere Research Department are always ready to collaborate with equipment manufacturers and operators in specification matters. • When it is time to re-tube, remember that conditions may have changed since the original installation, and that it may be wise to re-check before ordering new tubes. • To take advantage of Revere's knowledge of copper and copper alloy tubes for all industrial purposes, get in touch with the nearest Sales Office. See your telephone book or write direct. Send for helpful booklet, "Life Extension for Condenser Tubes." Free.

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nate the field. At the present time there are about 150 companies producing petrochemicals, only a third of which are oil refiners.

The most important reasons advanced for this split are:

- Need for active development of new products through an extensive research and development program.
- Need for accumulating intricate process know-how.
- Obsolescence of both products and facilities.

All these are more typical of chemical than petroleum operations. However, in the last few years, several petroleum companies have set up large research centers to handle the complex problems of the chemical industry and they are now competing very successfully.

▶ **Costs High**—The magnitude of investment for a petrochemicals plant and the probable return on investment are factors which are sometimes not too well understood. Unlike some chemical operations, it's hard to realize more than a dollar of sales per dollar of plant investment in a basic petrochemical unit. Also, profit per dollar of plant investment is usually comparatively rather low.

Cost of a petrochemicals plant per pound of product may be four or five times that of a petroleum refinery. Therefore, one might question the interest now being shown by new companies entering the field to compete with older established groups. One explanation is that the manufacture of basic petrochemicals is essential to get in on the more profitable upgraded products.

Instances of this are the conversion of styrene to resins used in emulsion paints; ethylene oxide to morpholine for nonrubbing floor waxes; or propylene to glycerine.

As a matter of fact, this is the basic reason why so many chemical companies have gone into petrochemicals. Their principal interests are to broaden their raw material supply base and to integrate their activities vertically. The petroleum companies have also recognized that entry into the field of petrochemicals permits a greater return from their crude oil through upgrading to products that demand premium prices.

▶ **Growth to Continue**—One of the most important reasons for the development of the petrochemical industry has been the abundant availability of raw materials at stable and economic prices. Occasionally we hear concern over the continuing availability of petroleum products for the chemical industry. One chart on page 266 shows the end use distribution of crude petroleum in 1954. Note that all miscellaneous uses—including chemicals—totaled only 6% of total crude oil production.

Actually, chemicals represent just a small portion of this segment. One estimate is that only 0.7% of total petroleum production was consumed in the manufacture of chemicals in 1950; and in spite of the tremendous predicted growth, only 2.7% of the total output will be consumed in chemicals in 1975. Expressed in the petroleum industry's yardstick (the barrel), total petrochemical output of the country in 1954 was only 230,000 bbl. of products a day. This is in the size range of a large Gulf Coast refinery.

In other words, a single large refinery could handle an equivalent of the entire national volume of petrochemicals. So there's no imminent danger of petrochemicals consuming enough petroleum to threaten our reserves.

▶ **Plenty of Gas, Too**—The other chart on page 266 shows the end use breakdown of natural gas. Domestic and commercial fuel uses account for by far the majority of the outlets for natural gas. Chemicals and other industries account for only about 25% of total gas production. Even here the use is principally as a fuel in competition with oil or coal rather than as a raw material for chemical synthesis. The chemical industry by itself took about 3% of the total natural gas consumption in 1954.

A second important factor contributing to the growth of petrochemicals has been technical improvement of processes. While one might write at length on developments in this field, we'll cite only a few:

- Steam reforming and partial oxidation of natural gas—and more recently fuel oil—for the production of ammonia and other products derived from synthesis gas.
- Catalytic oxidation route to ethylene oxide which will essentially make obsolete the two-step

INDEX: 1935=100

Business Activity

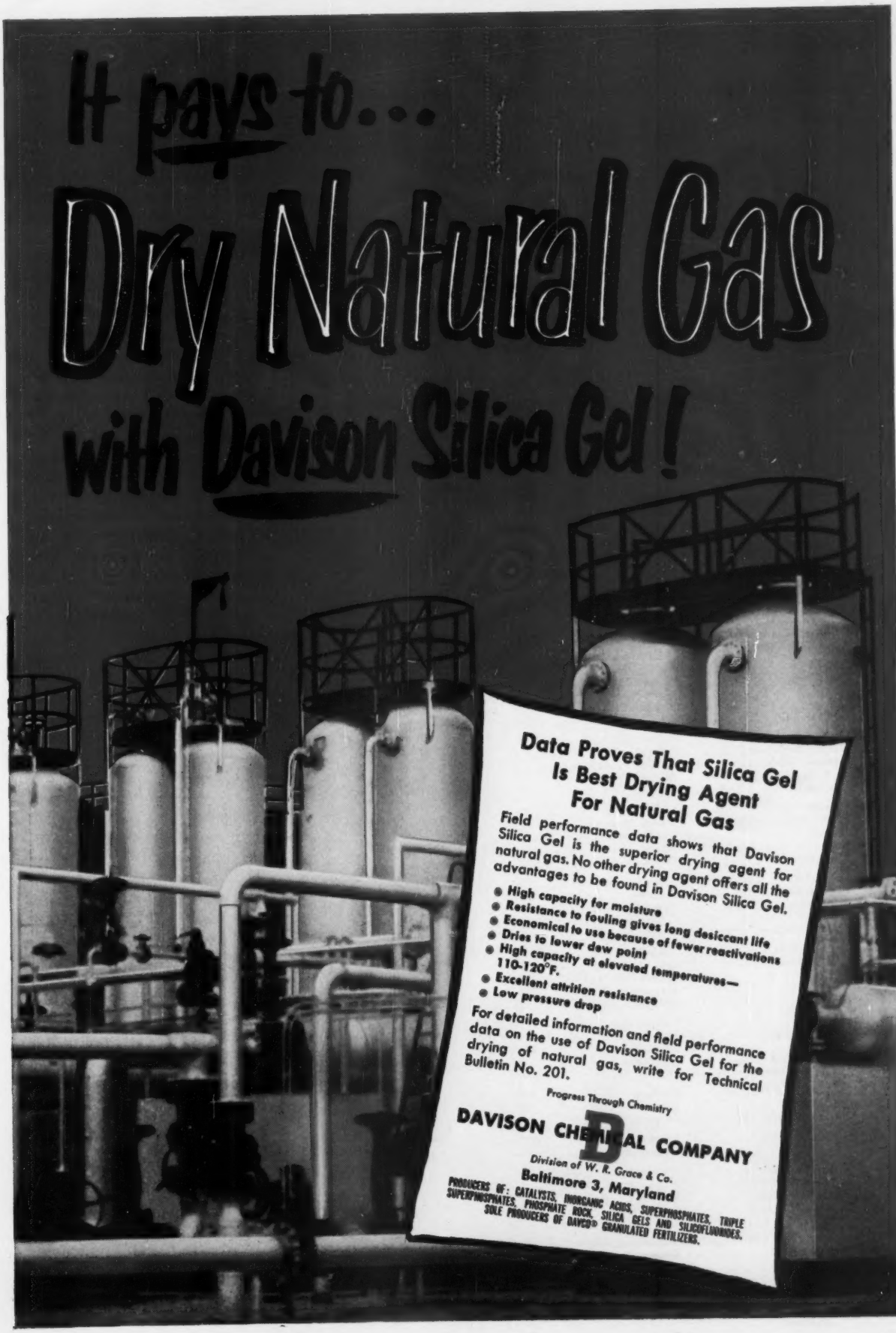
June	315.3

Chemical Consumption

May (preliminary)	310.81
April (revised)	311.61

Chemical Consumption by Industries

	May	April		May	April
Fertilizer	70.18	77.49	Paint & varnish	32.71	32.49
Pulp & paper	36.39	34.82	Textiles	10.59	10.31
Petroleum refining	29.30	27.84	Coal products	12.77	12.24
Iron & steel	18.94	18.00	Leather	4.29	4.29
Rayon	29.29	30.79	Explosives	9.40	9.02
Glass	26.43	24.76	Rubber	7.45	7.12
			Plastics	23.07	22.44


It pays to...
Dry Natural Gas
with Davison Silica Gel!
Data Proves That Silica Gel Is Best Drying Agent For Natural Gas
Field performance data shows that Davison Silica Gel is the superior drying agent for natural gas. No other drying agent offers all the advantages to be found in Davison Silica Gel.
● High capacity for moisture
● Resistance to fouling gives long desiccant life
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For detailed information and field performance data on the use of Davison Silica Gel for the drying of natural gas, write for Technical Bulletin No. 201.
Progress Through Chemistry
DAVISON CHEMICAL COMPANY
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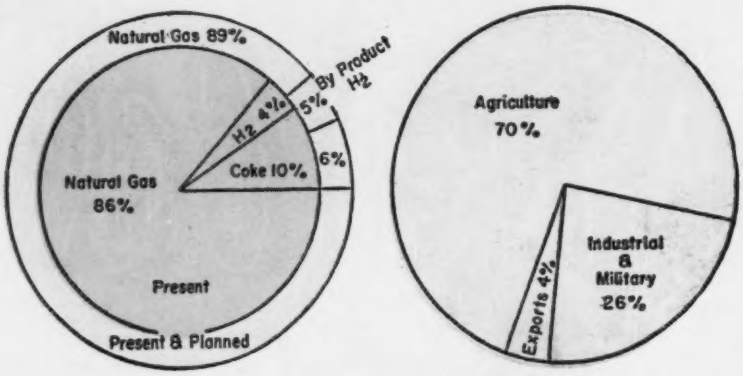
PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, TRIPLE SUPERPHOSPHATES, PHOSPHATE ROCK, SILICA GELS AND SILICOFLUORIDES.
SOLE PRODUCERS OF DAVCO® GRANULATED FERTILIZERS.

Anhydrous Ammonia, 1954 (2.76 million tons produced)



U. S. Ammonia Capacities (Thousand Tons/Year)

Company	Location	Jan. 1955	Completed By End 1955	Financed	Proposed
Allied Chemical	Hopewell, Va.	345	50		
	South Point, Ohio	273			
	La Platte, Neb.	75	75		
American Cyanamid	Avondale, La.	105			
Atlantic Refining	Philadelphia, Pa.	35			
Bree Chemical	Wilmington, Calif.	82			
Calumet Nitrogen Products	Hammond, Ind.			105	
Columbia River Chemical	Pasco, Wash.				42
Columbia-Southern	Natrium, W. Va.		25		
Commercial Solvents	Sterlington, La.	135			
Co-op. Farm Chemicals	Lawrence, Kan.	55			
Deere & Co.	Pryor, Okla.	63			
Dow Chemical	Freeport, Tex.	35	35		
	Midland, Mich.	16			
	Pittsburg, Calif.	7			
Du Pont	Belle, W. Va	230			
Du Pont	Niagara Falls, N. Y.	10			
Escambia Bay Chemical	Pensacola, Fla.			70	
Gonzales Chemical	Guanica, Puerto Rico			42	
W. R. Grace	Memphis, Tenn.	87			
Hercules Powder	Hercules, Calif.	50			
Hercules Powder	Louisiana, Mo.	42			
Hooker Electrochemical	Tacoma, Wash.	22			
Jefferson Chemical	Port Neches, Tex.				70
Ketona Chemical	Ketona, Ala.			45	
Lion Oil	El Dorado, Ark.	210			
Lion Oil	Luling La.	105			
Merck & Co.	Alabama				70
Mississippi Chemical	Yazoo City, Miss.	63	37		
Mississippi River Fuel	Crystal City, Mo.			70	
National Distillers	Tuscola, Ill.		50		
Northern Chem. Industries	Sandy Point, Me.			44	
Olin Mathieson Chemical	Lake Charles, La.	110			
	Niagara Falls, N. Y.	7			
	Morgantown, W. Va.	230			
Pennsalt	Wyandotte, Mich.	33			
Pennsalt	Portland, Ore.		6		
Phillips Chemical	Etter, Tex.	160	6		
	Houston, Tex.	157			
Phillips Pacific Chemical	Washington				70
San Jacinto Chemical	Houston, Tex.	40			
Shell Chemical	Pittsburg, Calif.	105			
	Dominquez, Calif.	54			
Southern Nitrogen Corp.	Savannah, Ga.				88
Spencer Chemical	Pittsburg, Kan.	180			
	Henderson, Ky.	80			
Spencer Chemical	Vicksburg, Miss.	70			
St. Paul Ammonia Products	St. Paul, Minn.			70	
Standard Oil (Calif.)	Richmond, Calif.			105	
Standard Oil (Ohio)	Lima, Ohio			105	
Sun Oil	Philadelphia, Pa.			105	
TVA	Wilson Dam, Ala.	91			
U. S. Steel	Geneva, Utah			70	
Westvaco	Charleston, W. Va.			21	
Total		3,362	284	852	340
Total Nitrogen		2,620	234	702	280

process using chlorine as a raw material.

• Development of synthetic glycerine.

• Development of improved furnace black processes for making carbon black particularly suitable for GR-S rubber.

The manufacture of acetylene from hydrocarbons by either pyrolysis or oxidation might also be cited. Many feel that this type of process will largely replace calcium carbide as a source of acetylene.

▶**Must Make Markets**—Another major factor contributing to the growth of petrochemicals is the development of markets for the basic products. We can't overlook the fact that petrochemicals have so saturated the demand for synthesized materials in some respects that they now compete with one another for certain markets.

This is particularly true of the rubber industry, which is the principal outlet for petrochemicals. Of all originally produced elastomers in 1954, approximately 50% were synthetic. With the exception of neoprene, most of the synthetics are derived from petrochemicals.

While intercompetition of petrochemicals for certain markets represents a healthy state of affairs—brings about improvements in consumer products—a more desirable objective might be to develop synthetic products to replace goods now based on naturally occurring materials available in limited supplies.

Frequently, of course, by minor modifications, it's possible to manufacture synthetics with properties superior to natural products. This generates entirely new outlets for chemicals and contributes in a major way to the growth of our over-all economy.

▶**No End in Sight**—Growth of the petrochemicals industry in the United States will continue, assuming new markets are developed to use the many new chemicals that will be produced. More than adequate supplies of raw materials will continue to be available.

Perhaps the most critical limiting factor will be our ability to provide capable scientists and en-

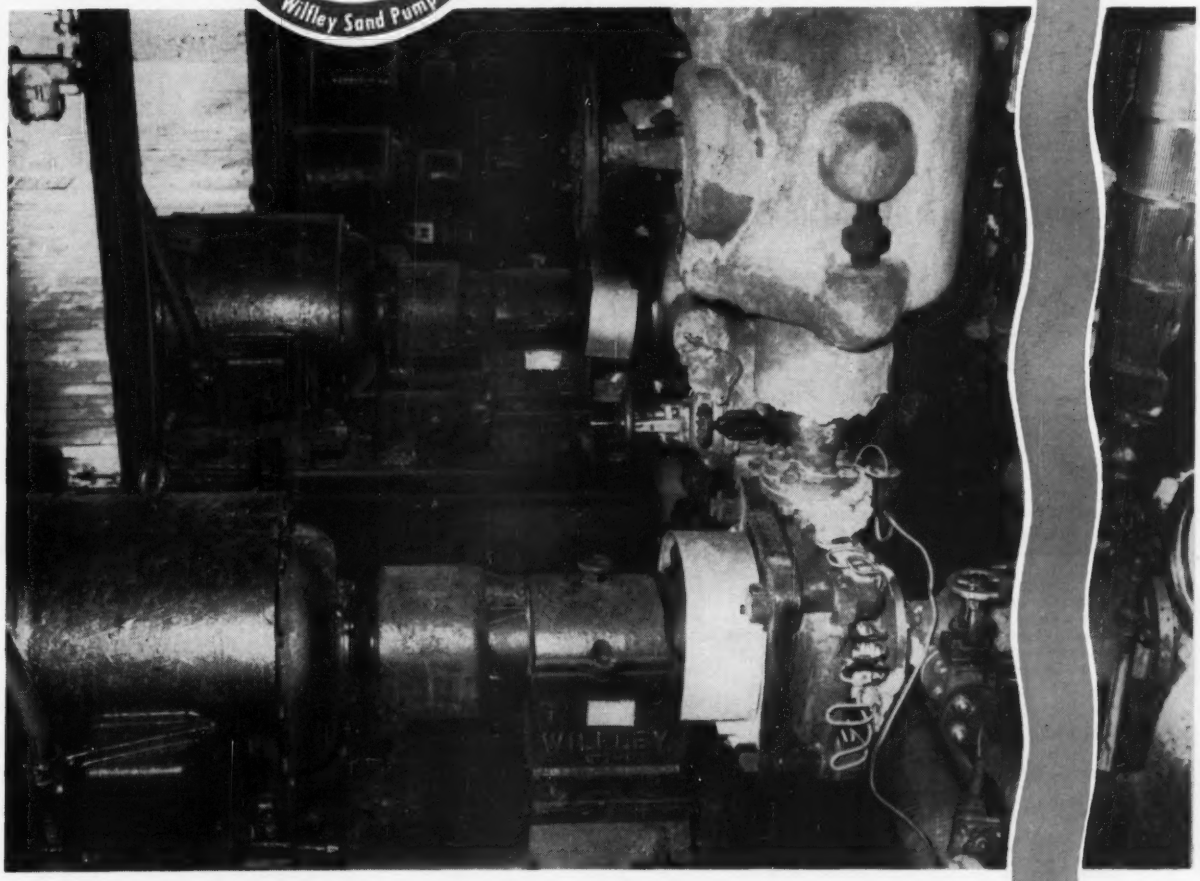
WILFLEY ACID PUMPS handling

Ammonium Nitrate at HIGH HEADS!

These highly efficient Wilfley Acid Pumps step up production and reduce pumping costs in this modern chemical plant. Wherever installed, Wilfley Pumps operate without attention, delivering trouble-free performance on 'round-the-clock schedules. Available with pumping parts of the machinable alloys as well as plastic to meet all requirements. Individual engineering on every application. Write or wire for complete details.

Wilfley Acid Pump
"COMPANIONS IN ECONOMICAL OPERATION"
Wilfley Sand Pump

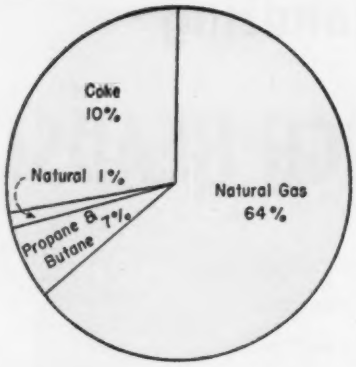
Photo shows prilling tower pumps (steam jacket partially removed).



A. R. WILFLEY and SONS, INC. Denver, Colorado, U.S.A.
New York Office: 1775 Broadway, New York City

Methanol, 1954 (1,112 million lb. produced)

Sources



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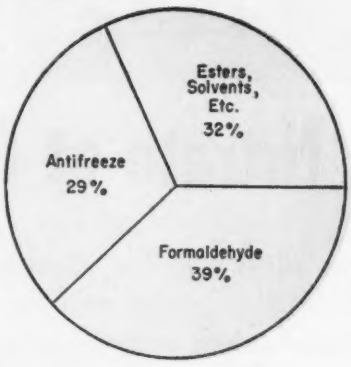
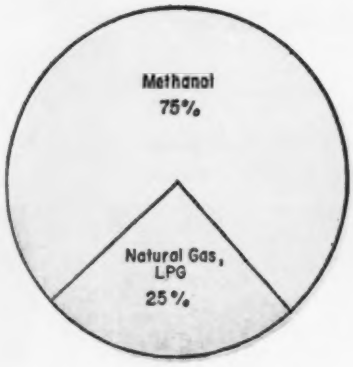


Formalin, 1954 (1,030 million lb. produced)

Sources



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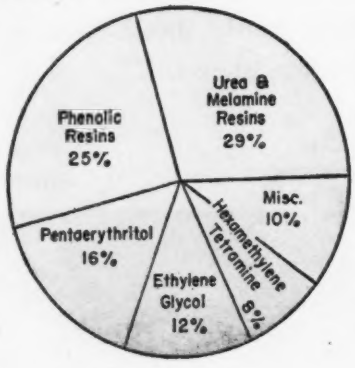

U. S. Methanol and Formalin Capacities, 1954

Producer	Plant Location	Methanol (Million Gal.)	Formalin (Million Lb.)
Allied Chemical	South Point, Ohio	18	108
Borden Co.	Bainbridge, N. Y.	...	36
	Demopolis, Ala.	...	40
	Springfield, Ore.	...	24
Celanese	Bishop, Tex.	11	200
	Pampa, Tex.	...	small
Cities Service Oil	Tallant, Okla.	2	22
Commercial Solvents	Agnew, Calif.	...	16
	Sterlington, La.	40	...
	Peoria, Ill.	2	...
Du Pont	Belle, W. Va.	50	175
	Orange, Tex.	40	...
	Perth Amboy, N. J.	...	150
	Toledo, Ohio	...	60
Durez Plastics & Chemicals	North Tonawanda, N. Y.	...	30
Heyden Chemical	Garfield, N. J.	...	175
	Fords, N. J.	...	60
	Texas City, Tex.[1]	25	...
Kay-Fries Chemicals	W. Haverstraw, N. J.	...	15
Merck & Co.	Danville, Pa.	...	150+[2]
Monsanto Chemical	Indian Orchard, Mass.	...	85
Olin Mathieson Chemical	Morgantown, W. Va.	9	...
Reichhold Chemicals	Tuscaloosa, Ala.	...	30
	Charlotte, N. C.	...	25
	Seattle, Wash.	...	24
	Ballardvale, Mass.	...	22
Rohm & Haas	Bristol, Pa.	...	25
	Bridesburg, Pa.	...	25
Spencer Chemical	Calumet City, Ill.	...	35
	Pittsburg, Kan.	10	...
Union Carbide	Bound Brook, N. J.	...	140
	Niagara Falls, N. Y.	6	...
	South Charleston, W. Va.	12	...
	Texas City, Tex.	18	...
Warren Petroleum	Conroe, Tex.	...	8
Total		243	1,680

[1] Joint operation with Monsanto.
[2] Not operating.

gineers to carry out the necessary research and development work.

► **Methane Mothers Many**—Let's consider now the compounds that are produced from the principal hydrocarbons available in petroleum and natural gas. First and simplest is methane. There are now several processes being used to convert this material into various petrochemicals.

The most important of these are the so-called reforming and partial oxidation processes for production of synthesis gas. This is the basic step in making ammonia, by far the largest-volume petrochemical now in production. By the end of this year there will be 42 U.S. plants making synthetic ammonia (*see table, p. 270*) with rated capacity of nearly 3.7 million tons a year.

► **Methyl Alcohol's Big**—Methanol is the second most important product made by reforming methane from natural gas. It can be made interchangeably in some of the same facilities used for the production of ammonia. Thus, production capacity could be expanded considerably over current levels. Output in 1954 was estimated at about 1.1 billion lb.

As shown at left, natural gas accounted for about 64% of all methanol produced. Principal methanol outlets are in the production of formaldehyde as well as in solvents and anti-freeze. Methanol has captured most of the volatile antifreeze market, but it will continue to find strong competition from ethylene glycol permanent antifreeze.

Also at left are shown the sources and end uses of formaldehyde. As indicated, methanol is the base for about 75% of all formaldehyde production, with the oxidation of natural gas and LPG (liquefied petroleum gas) accounting for the remainder. Phenolic resins and urea and melamine resins are the principal outlets for formaldehyde. Increased formaldehyde demand is expected because of the dynamic character of the plastics industry as a whole.

► **Other Methane Uses**—Other major uses for methane are in the

what are good little Yarway Impulse Steam Traps made of?

STAINLESS STEEL, *of course*

Body and all internal parts of YARWAY Impulse Steam Traps are of *stainless steel*—one of the biggest steps taken by any trap manufacturer to increase trap life and reduce maintenance.

Other YARWAY Impulse Steam Trap features:

- **Gets equipment hot in a hurry—and keeps it hot.**
- **Good for all pressures without change of valve or seat.**
- **Easy installation—small size, light weight.**
- **Non-freezing at low temperatures.**
- **Six standard sizes, ½" to 2".**

Want *proof* of performance? Try a YARWAY Impulse Trap and Fine Screen Strainer FREE for 90 days in your own plant. For free trial or free Trap Selector, write . . .

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OVER 1,000,000 YARWAY IMPULSE TRAPS SOLD—STOCKED BY 270 CONVENIENT INDUSTRIAL DISTRIBUTORS

YARWAY
impulse steam trap

U. S. Producers of Chloromethanes

Methyl Chloride, 1954—65 million lb. produced

Producer	Plant Location
Allied Chemical	Moundsville, W. Va.
Ansul Chemical	Marinette, Wis.
Diamond Alkali	Belle, W. Va.
Dow Chemical	Freeport, Tex.
Dow-Corning	Midland, Mich.
Du Pont	Niagara Falls, N. Y.
General Electric	Waterford, N. Y.

Methylene Chloride, 1954—60 million lb. produced

Producer	Plant Location
Allied Chemical	Moundsville, W. Va.
Diamond Alkali	Belle, W. Va.
Dow Chemical	Freeport, Tex.
Du Pont	Niagara Falls, N. Y.

Carbon Tetrachloride, 1954—300 million lb./yr. capacity

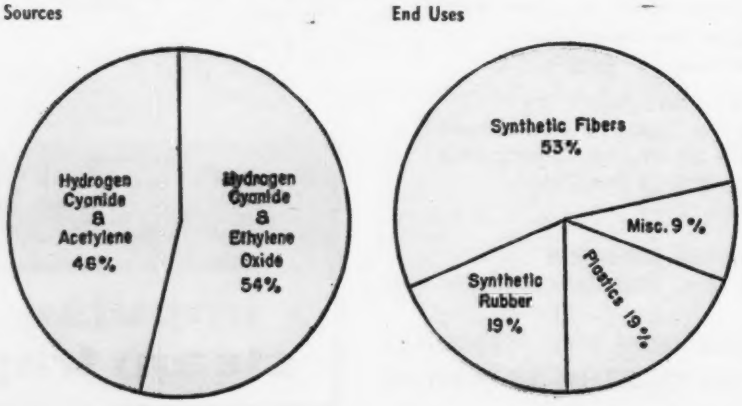
Producer	Plant Location
Allied Chemical	Moundsville, W. Va.
Diamond Alkali	Painesville, Ohio
	Belle, W. Va.
Dow Chemical	Freeport, Tex.
	Pittsburg, Calif.
Stauffer Chemical	Niagara Falls, N. Y.
	Louisville, Ky.
Westvaco	South Charleston, W. Va.

manufacture of chlorinated solvents and hydrogen cyanide. Dow Chemical, Diamond Alkali and Allied Chemical's Solvay Process Div. all operate plants that chlorinate methane directly to carbon tetrachloride, chloroform, methylene chloride and methyl chloride. These products are in active demand for use in paint removers, in the manufacture of freons, in silicone resin production and in fire extinguishers.

Hydrogen cyanide is obtained by reacting methane with ammonia. This is a relatively new technique that may replace some of the older installations that now use electrochemical methods. While cyanides go into electroplating, dyes, fumigation, etc., their greatest potential lies in chemicals, particularly acrylonitrile.

To make acrylonitrile, hydrogen cyanide is essential whether acetylene or ethylene oxide is used as the other basic raw material. As shown below, current production of acrylonitrile is estimated at about 70 million lb., though capacity is estimated at twice this figure. Synthetic fibers represent the biggest outlet for acrylonitrile, followed by synthetic rubber.

Acrylonitrile, 1954 (70 million lb. produced)



Masonry Paint Sales Still Climbing Fast

Nearly 9 million gallons of exterior masonry paints will be used on residential dwellings this year, the greatest volume ever. This prediction, by John Platner of Goodyear Tire & Rubber's Chemical Division, is based on two prime trends: Anticipated high level of new building construction and the increased use of cement asbestos shingles on new homes.

Going beyond this year, Platner predicts sales of these paints in 1960 will be 37% over 1955. And by 1975, consumption should hit 24 million gallons.

New Survey Sees 1955 As Record Sales Year

All-time production and sales records will highlight American industry in 1955. That's what the Business and Defense Services Administration found in its recent mid-year survey of 25 major industry groups. A similar survey at the start of 1955 indicated a general high level of production, but such industries as chemicals, steel, rubber and automobiles have far surpassed expectations.

Here's what BDSA sees for some of the process industries:

• Chemicals—Extensive use of chemicals throughout industry, especially synthetic fibers and plastics, plus continuing high industrial activity and the end of general inventory liquidation all point to second-half chemical sales at or close to this year's first-half levels. This indicates total chemical sales of more than $22 billion, 12-15% better than in 1954.

• Rubber—New high in domestic rubber consumption was set in early 1955. Total for the year should be 1.4 million long tons, compared with the previous record of 1.338 million in 1953. Consumption abroad is also setting new records with price of natural rubber well above that of synthetic. Synthetic production, now in private hands, should run at capacity all year, with expansion coming soon. (Continued)

HOW STAINLESS STEEL *brings a whole set of advantages to critical processing jobs*

This 60-inch diameter nitric acid absorber tower typifies the application of stainless steel in the chemical processing industry. Made by the Vulcan Manufacturing Division of Cincinnati, Ohio, it is an excellent example of how several properties of a *specific type* of stainless team up to solve a tough chemical processing problem.

The stainless that Vulcan chose for the all-welded body is Crucible Rezistal® Type 347. Here are three big reasons why:

High tensile strength to minimize structural support.

Stability against formation of harmful carbides, both during welding and in high-temperature operation.

Remarkable corrosion-resistance to withstand lasting exposure to nitric acid. It is fully resistant to the acid in diluted form at any temperature, and to concentrated solutions at lower temperatures. It is satisfactorily resistant to concentrated solutions above the boiling point.

Your operations may not call for nitric acid absorber towers, but if they include any critical phase of chemical processing, check the many advantages offered by the 30 available types of Crucible stainless steel. You'll find details in "Making the Most of Stainless Steels in the Chemical Processing Industry," which is yours free on request. And, to find out what information is available on the many other Crucible special steels, ask for "Crucible Publication Catalog." Or consult your nearby Crucible representative. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

ECONOMICS . . .

• Pulp and Paper—Based on first-half figures, production of pulp, paper and paperboard should establish a new record of more than 28 million tons. Last year's output was 26.7 million tons.

• Textiles—The market for textiles has been slowly gathering strength all year and good volume at somewhat better prices is expected in the last six months. This should put mills in a better financial position than last year. Man-made fibers continue to boom in practically all uses.

• Aluminum—Shipments of aluminum will set an all-time record of over 3.7 billion lb. in 1955. This is 500 million lb. more than the industry expected at the beginning of this year and 700 million lb. more than was shipped in 1954. Military shipments will be about the same as last year.

GUIDED TOUR CONTINUED

PICTURED FLOWSHEET

Not for the Novice: Making Acrylonitrile 288

NAMES IN THE NEWS

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COMING SOON

How to select and use safety relief valves . . . . . Oct.

Chlorine plants and the 0.6 factor . . . . . Oct.

Present-day urea processes compared . . . . . Oct.

Water treating: Equipment, operations, costs . . Oct.

Drying equipment: A report . . . . . Oct.

Mechanical design features of heat exchangers . Nov.

New non-aqueous cement process . . . . . Nov.

Drying applications and costs: A report . . . . . Nov.

How to make acrylonitrile.

Reacting acetylene with hydrocyanic acid is definitely not for the novice. Here's how American Cyanamid does it at the new Fortier, La., plant. (p. 288)

Find it hard to keep up?

Maybe you should keep closer tabs on new reference books coming out. Technical bookshelf is your monthly guide. (p. 306)

New technical literature!

You can now get—free and fast—literature on any subject in your field. Keep your files up to date the easy way. (p. 420)

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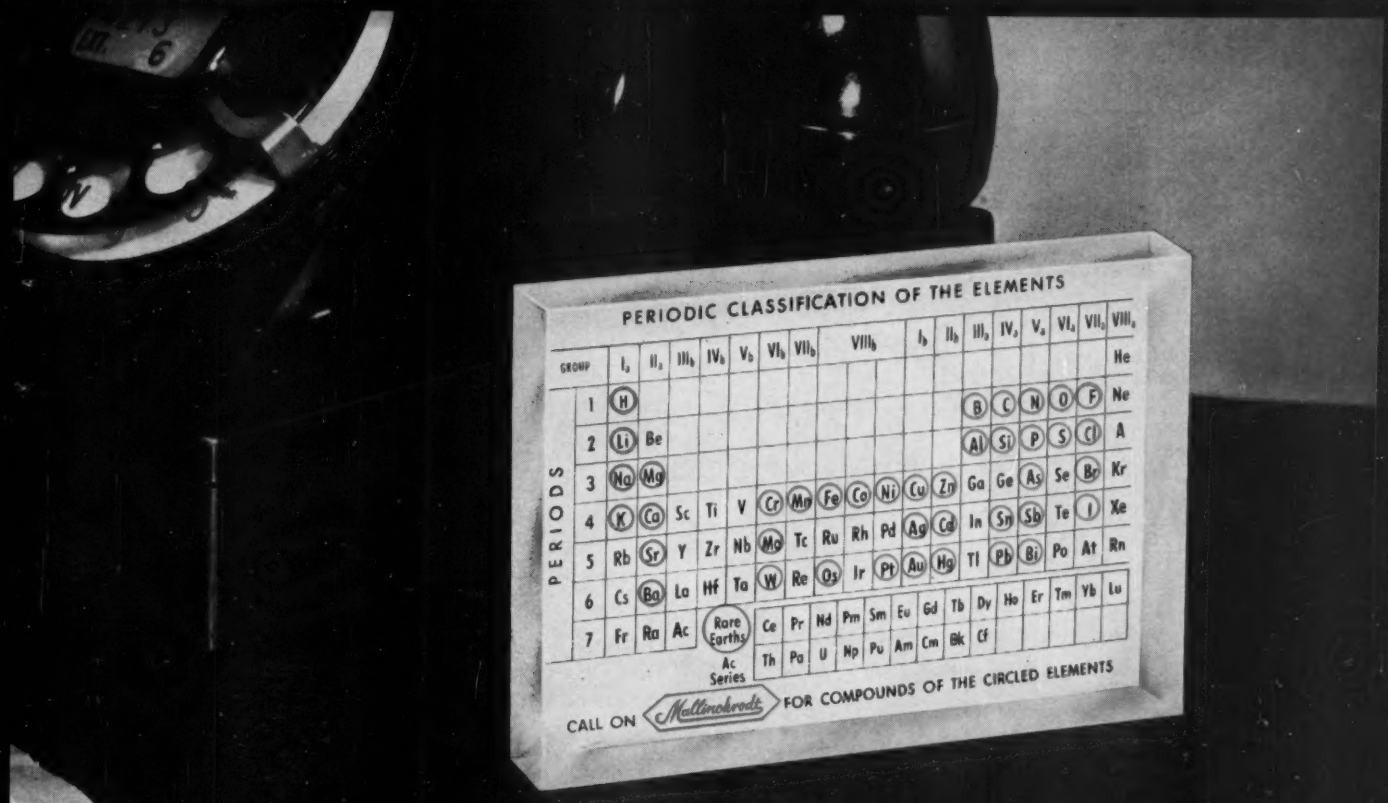
Inside Back Cover



The most elementary consideration in any process is *what you start with.* Your best engineered process and your finest equipment will not produce satisfactory products unless the starting materials—especially chemicals—are exactly right. And in the end, using the *right* chemical often saves money even at slightly higher first cost. More than 200 process industries have come to depend upon Mallinckrodt for *their* chemicals because they know Mallinckrodt can supply chemical needs promptly and in quantity. *Mallinckrodt's flexible production facilities are geared to the precision manufacture of chemicals from a few tons to carload lots.*

Write for our brochure which lists and describes some of the many Mallinckrodt chemicals and their uses.

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Manufacturers of chemicals for industrial, medicinal, photographic and analytical uses

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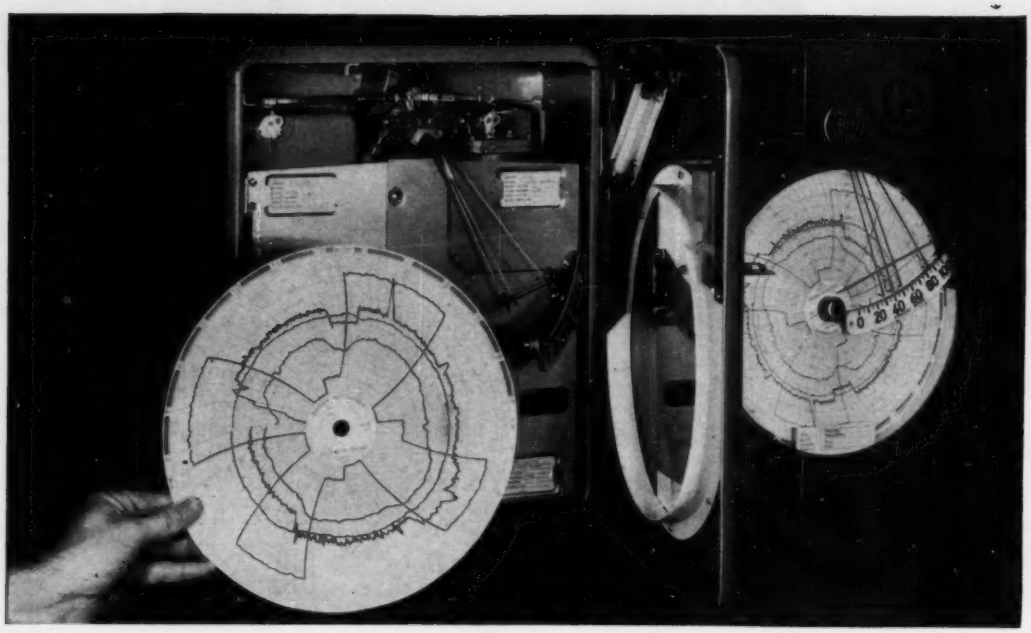

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Clear, Continuous Records without Poisoning . . . on the New Bailey Recorder

★ Faithful chart records of measured variables are the key to a meaningful, dependable analysis of operating trends and conditions. Money spent for more accurate metering, for faster response, is money down the drain—*unless* it's matched with chart records that are equally accurate.

That's why these features of the new Bailey Recorder are important to you:

1. Bailey's exclusive sealed capillary-action inking system maintains continuous flow to the pen tip, and traces sharp, opaque, quick-drying records. "Poisoning" of intersecting records is practically eliminated; no blots or smears during operation or chart changing.

2. Pens are mounted on concentric centers, trace on parallel time arcs only 42/1000" apart. This simplifies analysis of two or more records.

3. Interchangeable plug-in receiver units permit practically limitless record-grouping combinations.

Write for Product Specification E12-5 and actual chart sample. P25-1

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- Pre-calibrated plug-in receiver units
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Controls for Power and Process

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Controls for
TEMPERATURE
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GAS ANALYSIS
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Now... your own painter can "COLD-GALVANIZE" any steel surface with DIMETCOTE

* the 100% inorganic zinc coating

any **PLACE**

any **TIME**

any **WHERE**

SPRAY *or* **BRUSH**

Dimetcote is absolutely unique. It is not a paint, it contains no oils, resins or any other organic materials, yet it can be applied by spray or brush. When Dimetcote is applied to steel, a reaction takes place at the surface which produces chemical bonding as well as physical adhesion. It is almost impossible to find the interface between Dimetcote and the steel.

Dimetcote has many unusual characteristics. It shows no visible change after more than ten years exposure to the most severe weather conditions – sun, heat, fresh and salt water. It is insoluble in all solvents and petroleum products. It is highly abrasion resistant, but if abraded through to bare steel, the coating will cathodically inhibit corrosion.

Now tanks and structures can be given the same protection that galvanizing affords, *plus salt water resistance.* Existing structures need not be dismantled and new structures can be coated either before or after erection. *Only one coat* of Dimetcote over a sandblasted surface is required to protect such structures as:

Tank Exteriors • Cargo Tanks in Tankers • Dam Gates • Structural Steel • Christmas Trees • Buoys • Floating Roof Tanks • Offshore Rigs • Water Tanks • Barges • Ship Decks • Stacks

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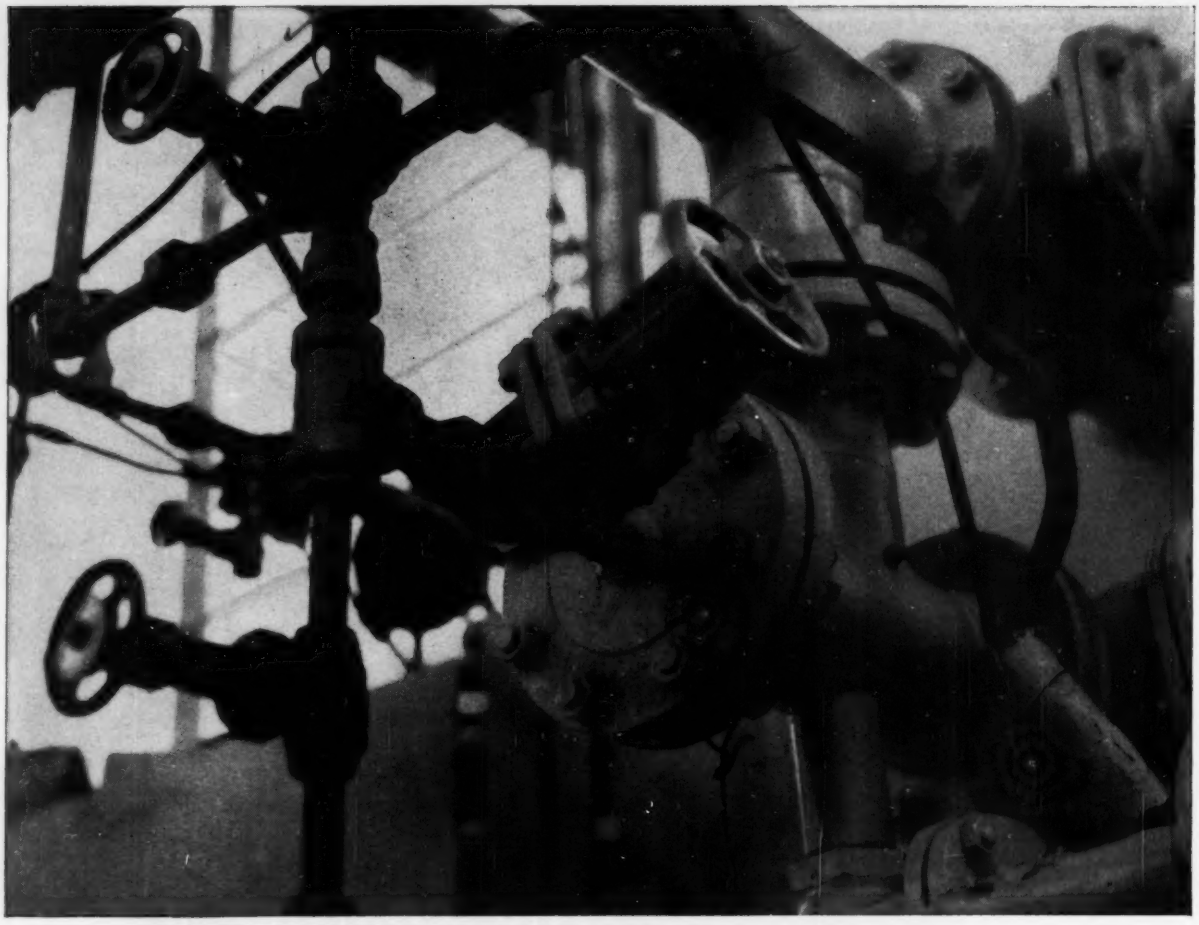

Valve of HASTELLOY alloy B, above, and others of the same nickel-base alloy installed in Shell Oil Company's refinery at Wood River, Ill., to assure adequate resistance to strong corrosives.

Where steel valves fail in a day... "HASTELLOY" alloy B lasts indefinitely

HANDLING SULPHURIC ACID (pH 2–5) on one side and live steam on the other, the valve in the center, above, lasts indefinitely . . .

Why? Because it's made of HASTELLOY alloy B, one in a series of nickel-base alloys produced and sold under the trade-mark "HASTELLOY", by Haynes Stellite Company, a Division of Union Carbide and Carbon Corporation, Kokomo, Indiana.

The valve illustrated serves the neutralizer unit in a large refinery. A carbon steel valve previously installed lasted only *one day*, which indicates the severity of the service.

This refinery also uses valves of HASTELLOY alloy B on a reboiler that recovers antimony trichloride and aluminum chloride. And, pumps of HASTELLOY alloy recycle the corrosive catalyst. At the bottom of a light oil treater in this refinery, you'll find a valve of alloy B handling sulphuric acid at varying strengths and temperatures up to 120°F.

Despite corrosive chemicals and live steam, these valves of nickel-base alloys, in most instances, last indefinitely without leakage.

Give your tough jobs to a HASTELLOY alloy or some other high-nickel alloy that you know will resist strong corrosives.

Whatever your metal difficulty, let us give you the benefit of our wide practical experience in this field. Write for List A of available publications. It includes a simple form that makes it easy for you to outline your problem.

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It's really simple. Go North American all the way. North American's specialized chemical tank cars transport your products with speed and safety anywhere there's a railroad main line, spur or siding. No contact with metal, no corrosive action, no chance for contamination, you specify the lining and we will obtain it for you . . . your chemicals arrive as clean and pure as you produced them. Specify North American, for chemical bulk shipping at its best.

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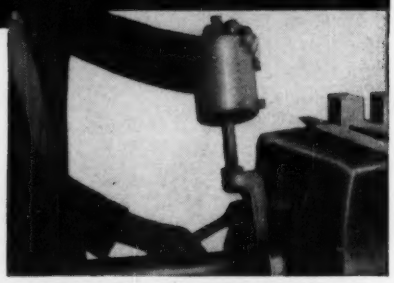
BRINGS NEW FILTRATION ECONOMY TO NEW OR EXISTING FILTER PRESSES!

Now — without re-boring . . . without altering parts . . . without removing so much as one plate — you can modernize your present filter press with one of the newest, most advanced of all labor-saving devices — the "HANDRAULIC" Closing Device by Sperry. (Or you can specify the "HANDRAULIC" as original equipment on new Sperry Filter Presses.)

On existing presses, simply remove one bolt . . . slip the "HANDRAULIC" in place . . . tighten the cap-screw . . . and that's it! Releases a powerful hydraulic surge for opening and closing the filter press . . . in seconds . . . without operator fatigue. And because the "HANDRAULIC" requires no extra support or foundation, it's practically portable. Replaces the filler block . . . takes up no extra space . . . and angles out of position to provide the maximum space for cleaning and maintenance.



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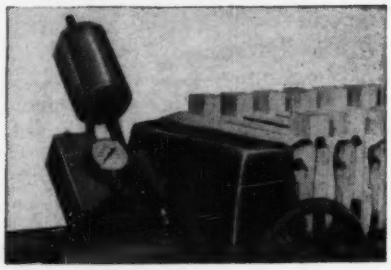
describing the "HANDRAULIC'S" simple erection and operating directions that can save you time, labor, material, and money. Also ask for Sperry's new, illustrated 42-page Filter Press Catalog. Both books are important . . . both are free. Send for your copies, today!



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Swing Handraulic to horizontal position, move slide head to open position, and filter press is ready for cleaning.

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By Heat Exchanger Specialists

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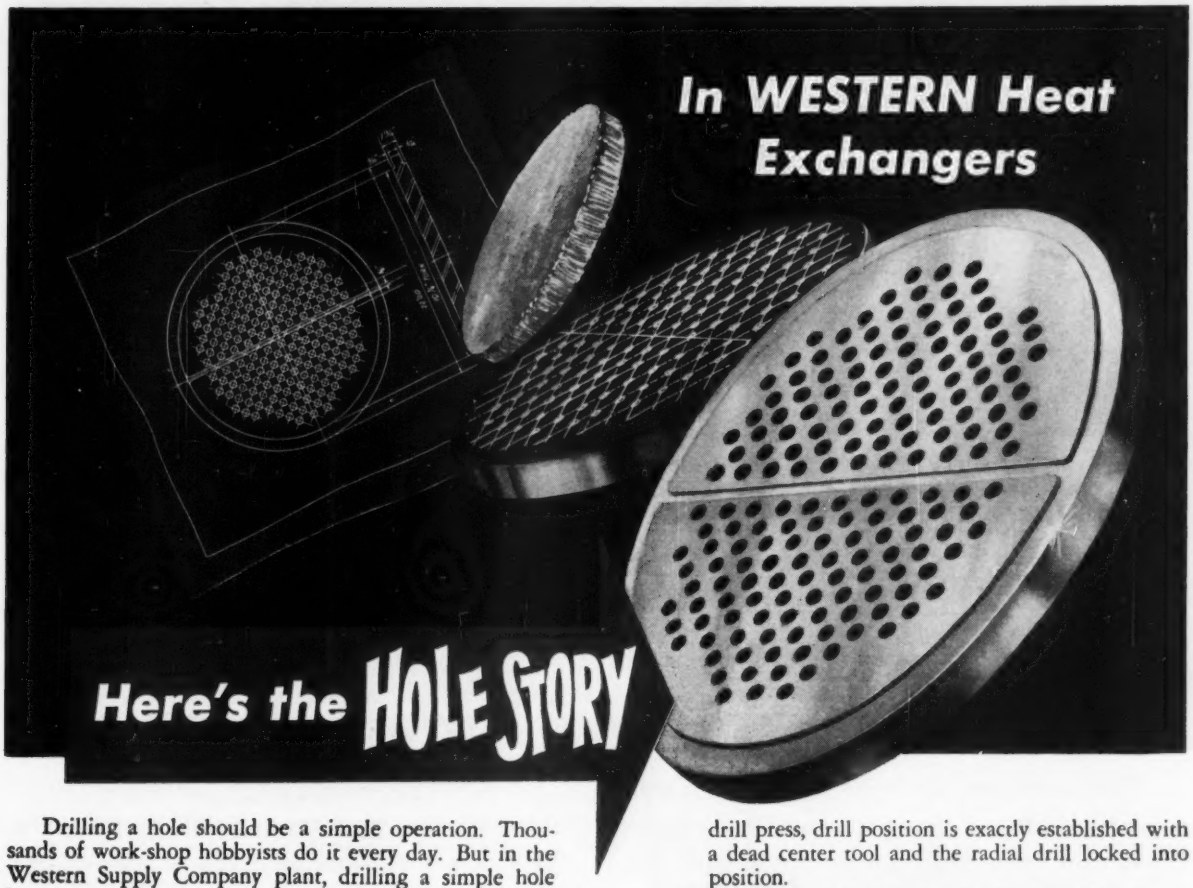
When fouling of heat exchanger tubes and shells is a tough problem . . . you can rely on the special metal design and fabrication experience of Western Supply Company.



Drilling a hole should be a simple operation. Thousands of work-shop hobbyists do it every day. But in the Western Supply Company plant, drilling a simple hole becomes a science.

These holes, in the stationary and floating tube-sheets must hold the heat exchanger tubes in a vapor or fluid-tight joint. Many tube-sheets have hundreds of such tube holes. A leak in any one, by permitting the mixing of shell-side and tube-side fluids, could prove costly, dangerous or both. To prevent this, TEMA (Tubular Exchanger Manufacturers Association) tube-hole tolerance for normal fit is plus/minus .002 of the specified tube hole diameter. In addition to tube hole diameter, the location of holes and accuracy of ligament between holes as well as tube hole drift are equally important factors.

To assure meeting TEMA specifications, Western's drilling technique is as follows:

1. After tube sheet machining, tube holes are scribed by the layout department.
2. Fully scribed, the hole locations are then carefully center punched.
3. With the completely layed-out tube sheet on the drill press, drill position is exactly established with a dead center tool and the radial drill locked into position.
4. The hole is drilled .015 under final specification.
5. The tube hole is reamed to size, normally .010 plus/minus .002 over nominal tube diameter.
6. All tube holes for Class R equipment have two 1/8" wide by 1/64" deep serrations.
7. All tube holes are chamfered 45° on both sides of tube sheet.
8. Tube sheets are chemically cleaned to de-grease prior to assembly.

That's "The Hole Story" behind every tube hole drilled at Western Supply Company for Western Heat Exchangers.

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HEAT EXCHANGERS

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P. O. BOX 1888 • TULSA, OKLAHOMA

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Choose from a wide range of standard Alcoa® Aluminum Bus Conductors for light, corrosion-resistant, economical bus systems

Whatever your installation or bus design problem is, there's an Alcoa Aluminum Bus Conductor so right for the job it's almost custom fabricated. Alcoa has developed shapes, alloys and tempers to meet the mechanical and electrical requirements for any bus conductor application.

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Tensile properties of Alcoa Aluminum Bus Bars are checked on this Baldwin-Southwark tension-testing machine, periodically calibrated to assure precision.

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Your Guide to Aluminum Value

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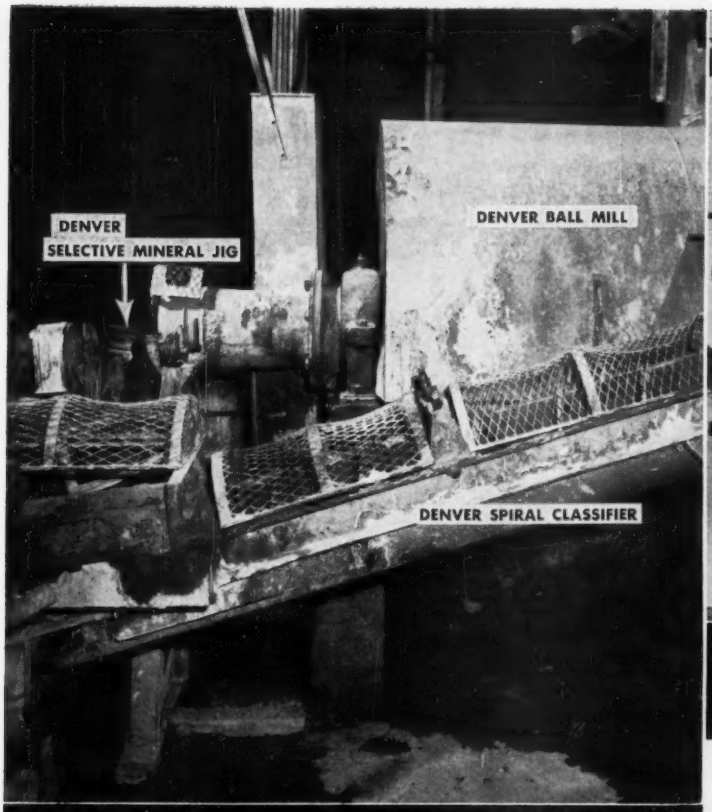
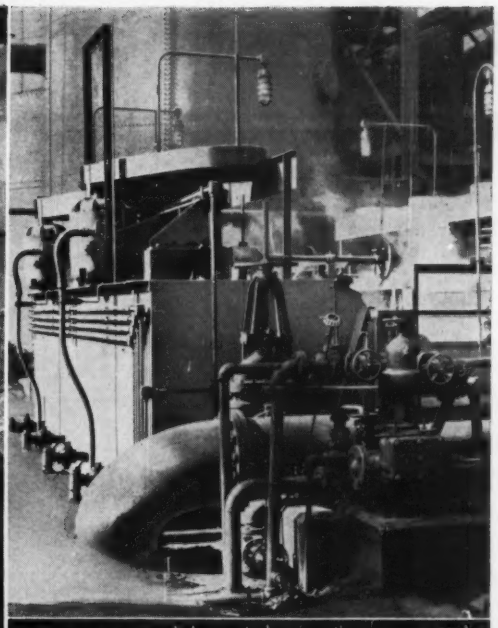
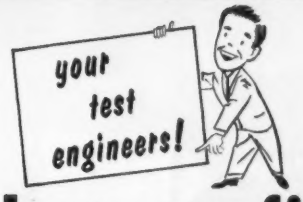


$3,000,000 Recovered Annually A Denver Reclamation System helps recover $3,000,000 in silver from waste photographic film and paper in the world's largest photo-chemical plant. Similar Denver Reclamation Systems in other industries recover platinum from refractory slag, aluminum, magnesium, zinc and manganese from slag, low ash coal from stream bottoms, and de-ink waste paper for re-use.



$64,000 Net Profit in 4 Months A large steel corporation recovers naphthalene from the cooling water in their coke plant with a Denver Reclamation System. Recovery of the by-product naphthalene is 100%. Sale of the by-product naphthalene produced a net profit of $64,000 in the first four months' operation.



DECO testing lab shows how profits can be recovered from industrial waste

If you have a valuable product in your industrial waste, find out how Deco can help you recover it at a profit. These case histories are a few examples of how company engineers have worked with the Denver Equipment Company to perfect reclamation systems. These systems have made profits for their owners.

Your engineers are welcomed in our laboratories. We have complete batch test and pilot plant facilities.

There is no obligation to you for a preliminary analysis and recommendation. Write today for details on how to send your samples.

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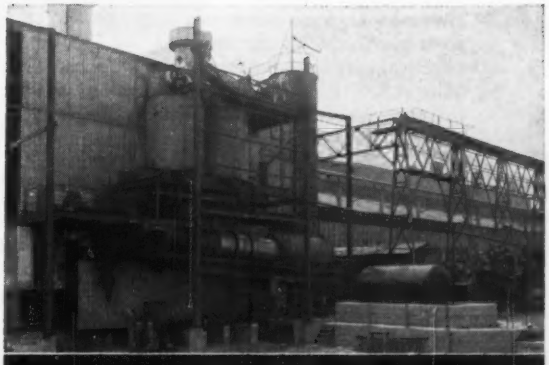


$43,000 Saved Each Year A Denver Reclamation System is reclaiming formerly discarded molding sand, and saving a large foundry this amount each year. Deco test investigations often can take an operator's or plant engineer's idea and develop a system producing a new profit—giving his plant a new competitive advantage in a profit-tight industry.

We are interested in tests on:

- ☐ Crushing
- ☐ Grinding
- ☐ Classification
- ☐ Flotation and Gravity Concentration
- ☐ Leaching
- ☐ Separation
- ☐ Waste Reclamation
- ☐ Sampling
- ☐ Filtering
- ☐ Settling
- ☐ Thickening
- ☐ Drying and Water Reclamation
- ☐ Anti-Polution Investigations

☐ Please send me Deco Bulletin "Industrial Application of Denver Equipment."

☐ Please send me complete information and bulletins on making Deco Laboratory Tests.

*Name*_____

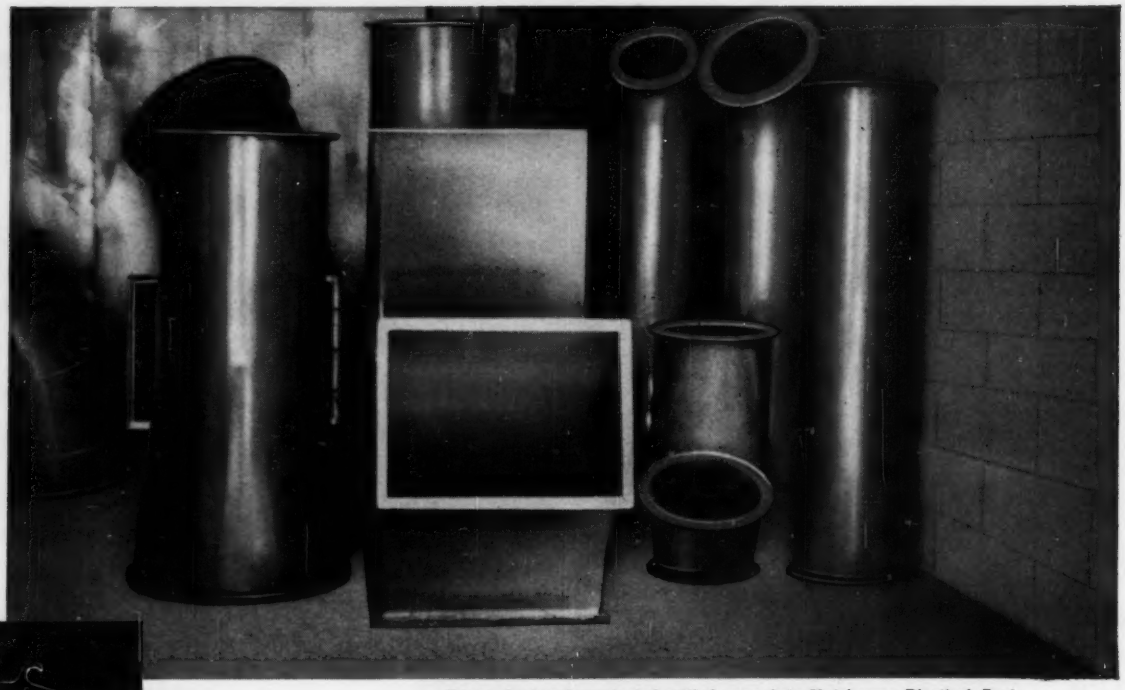
*Title*_____

*Company*_____

*Address*_____

*City and State*_____

Plastisol coatings can now do many more metal-protection jobs



Large ductwork protected with heavy duty Unichrome Plastisol Coatings. Photo courtesy Kaybar, Incorporated – Hazel Park, Michigan

Unichrome Coating 5300 *sprays on to give smooth coatings 20 mils thick or thicker*

Even large equipment can now be protected with plastisols. Unichrome Coating 5300 makes practical spray application of thick films. A short bake at 350° F turns this liquid, resinous material into a tough, rubbery and heavy duty vinyl film that makes ordinary metals fit for severest service conditions.

The first successful sprayable plastisol, Coating 5300 can be applied even to cold vertical surfaces in thicknesses up to 20 mils per dry coat. That's 5 to 20 times thicker than ordinary coatings. It assures protection free from seams, pores or "holidays".

And since Coating 5300 is a vinyl material, it withstands acids, alkalies, salt solutions, and a host of other chemicals and corrosives that attack ordinary coatings and the metals they are supposed to protect. Chemical inertness and heavy film buildup join up in the right combination for durable metal protection.

Unichrome Plastisol Compounds are also available for dipping, troweling and other methods of application. More information on the advantages of plastisols in Bulletin VP-1. Send for it!

For protection you apply like paint...

Various UCILON* Coating Systems are available that can do some of the jobs plastisols can do . . . and many that plastisols cannot do, especially on large structural work. Ucilon Coatings include vinyl, phenolic, fish oil, Neoprene, Thiokol, and chlorinated rubber types. Bulletin MC-8 gives details.

**Trade Mark*

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COATINGS FOR METALS

UNITED CHROMIUM DIVISION
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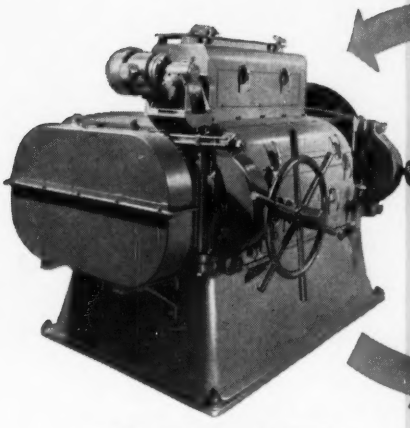
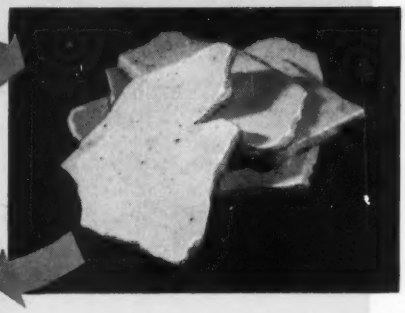
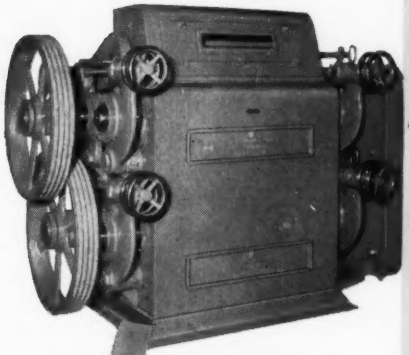
ALLIS-CHALMERS

PROCESS SYSTEM Converts Fine Particles Into Granular Product To Meet Consumer Demand

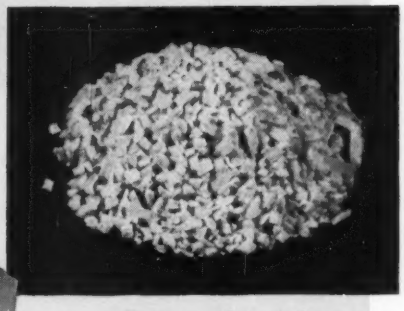


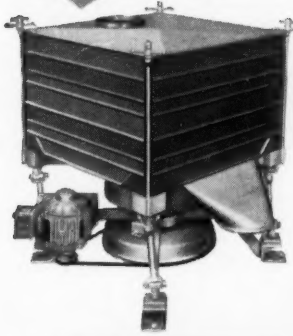
Compacting Mill





Roller Mill





Circle Sifter

1 Recovery operation starts with unacceptable minus 30 mesh chemical salt — fines created in original process.

2 An Allis-Chalmers heavy duty compacting mill is the principal component in the recovery system. The flakes or slabs illustrated are the result of mechanical densification in the compacting mill. An Allis-Chalmers two-pair high corrugated roller mill is used to granulate flakes. Final separation is made in the *Circle* sifter — an Allis-Chalmers gyratory screen. An 80% to 90% recovery of salable product is effected.

3 The resulting granules (100% minus 3 mesh and 100% on 10 mesh) equal or surpass natural product in every respect. Reconstituted product differs little from parent product in abrasion tests. Other tests have proved the compacted granule superior in controlled solubility. Granulated product is more uniform in particle size, flows more freely and has better "eye-appeal."

A-4743

For complete information, see your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 25C6177J.

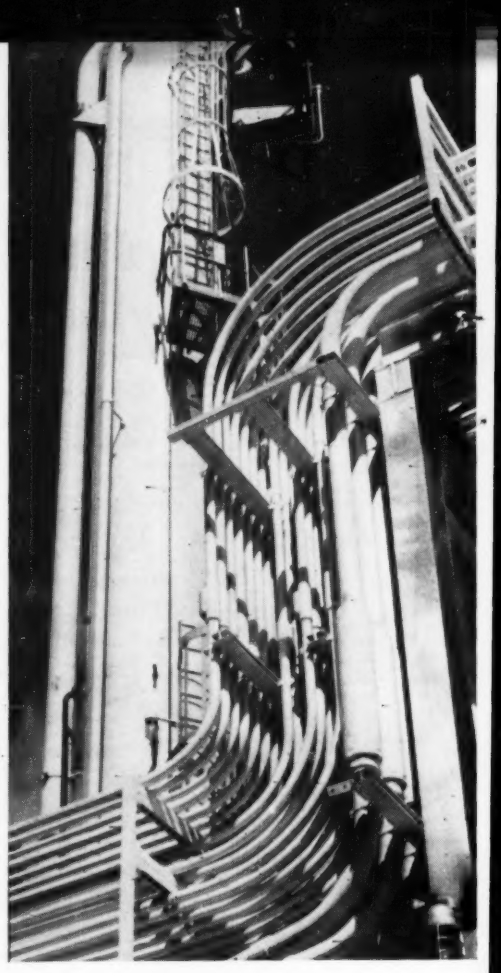
Circle is an Allis-Chalmers trademark.

ALLIS-CHALMERS

NOT FOR THE NOVICE: MAKING . . .

Acrylonitrile

Producing and reacting acetylene and HCN in acrylonitrile synthesis involves some tough problems. A good example of successful solutions: Cyanamid's new plant.



TOWER for acrylonitrile recovery.

Anyway you look at it, making acrylonitrile is not for the novice. Look at American Cyanamid's new $50 million, 50 million lb./yr. plant at Fortier, La. There, it's made by reacting acetylene with hydrocyanic acid. At Cyanamid's Warners, N. J. plant it's made via the "cyanohydrin" process—reacting HCN with ethylene oxide to form ethylene cyanohydrin, which is dehydrated to acrylonitrile.

The acetylene route has a definite advantage in that it uses a readily available raw material: natural gas. But some of the process problems solved at Fortier required some top-flight engineering:

• Take the acetylene unit. A BASF design, the process is based on partial oxidation of methane to supply heat for cracking the remaining methane to acetylene. But acetylene has a very short life at high temperatures—it was not possible to mix oxygen and hydrocarbon and react the two in the same area. The answer? A burner-reactor design that includes definite mixing and reacting zones. The reaction, in the design, is independent of speed of mixing. (See C.E. Nov. 1954, p. 116.)

• Or consider the acrylonitrile unit. One of the vital points here is to minimize the formation of divinylacetylene. It has a boiling point close to acrylonitrile, forms an azeotrope and is deadly in the monomer, because it is a cross-linking agent. Control of the reaction temperature and adjustment of the liquid phase catalyst (for promoting the reaction of HCN and acetylene) keeps DVA low.

► **Why All the Interest?**—Just seven years ago only one manufacturer (Cyanamid) made acrylonitrile monomer. Now there are four.*

All this activity is tied in directly with two important developments in fibers and plastics: an upsurge in acrylic fiber production (Orlon, Dynel, Acrilan) and increasing interest in acrylonitrile-styrene plastics

► **An Integrated Process**—To understand the full significance of the integrated process at Fortier, let's trace the flow of materials (see flowsheet) starting with acetylene production.

In two preheaters, oxygen (from Linde unit) and methane are heated separately to 1,110F. Both enter the mixing chamber of the burner, where thorough mixing takes place before ignition. At about 2,820F.:

$$2CH_4 \rightarrow C_2H_2 + 3H_2O$$

$$CH_4 + \tfrac{1}{2}O_2 \rightarrow CO + H_2O$$

Other products are water, carbon dioxide, carbon and higher acetylenes. For one ton of pure acetylene, 5.6 tons of 95% oxygen and 193 MSCF of natural gas are required.

The unstable burner gas is cooled to 195F. with a spray of water, which also carries down some of the carbon formed in the reaction. Further cooling takes place in a cooler—again using a spray of water. The gas then flows through a moving bed of wet coke for carbon removal.

► **Acetylene Purification**—Filtered gas, after combining with a stream of recycled acetylene enters the purification section. It is first compressed to 120 psig, then fed into a packed absorber.

In the absorber, solvent absorbs acetylene. The solvent loaded with acetylene then goes to a stripper where the pressure is lowered to 3 psia.

Acetylene collects at the bottom of the tower—a vapor side stream is taken off as product. Bottoms (acetylene, solvent) are rectified.

► **Making Hydrocyanic Acid**—At Fortier, the acid is prepared by reacting NH_3, CH_4 and air with a platinum alloy catalyst.

Preheated, mixed gases feed to a converter where the reaction takes place at about 1,830-2,190 F.

Water, CO, CO_2, H_2, N_2, NH_3 and HCN come out of the converter. This is all cooled by a spray of water to 203 F., then sent to an absorber, where ammonia is removed in a stream of sulfuric acid. In another absorber, HCN is removed in water and concentrated in a bubblecap column.

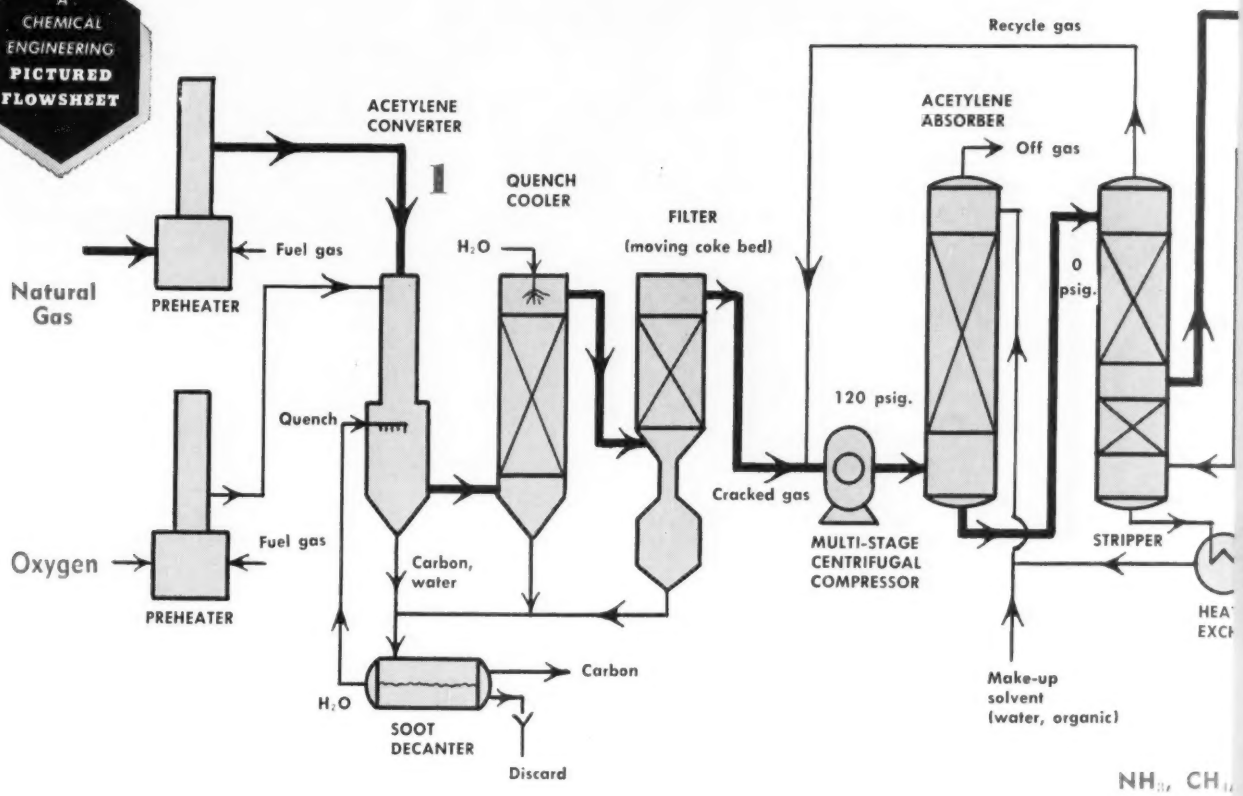
► **How to Make Acrylonitrile**—A liquid phase reaction between acetylene and hydrocyanic acid is used at Fortier. The synthesis centers around a liquid catalyst.

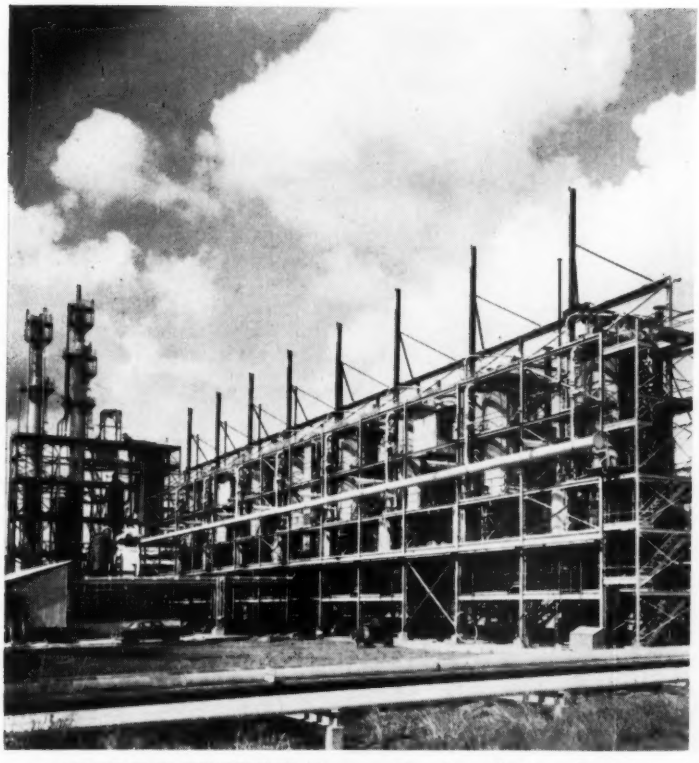
Besides acrylonitrile, acetaldehyde, vinyl chloride, methylvinylketone, chloroprene, polymers and condensation products form.

Gas from the rubber-lined reactor (acrylonitrile, water, by-products acetylene, HCN) is cooled and scrubbed with water to remove most of the acrylonitrile, unreacted HCN and solubles. This solution is sent to purification, where acetylene, low and high boilers are removed.

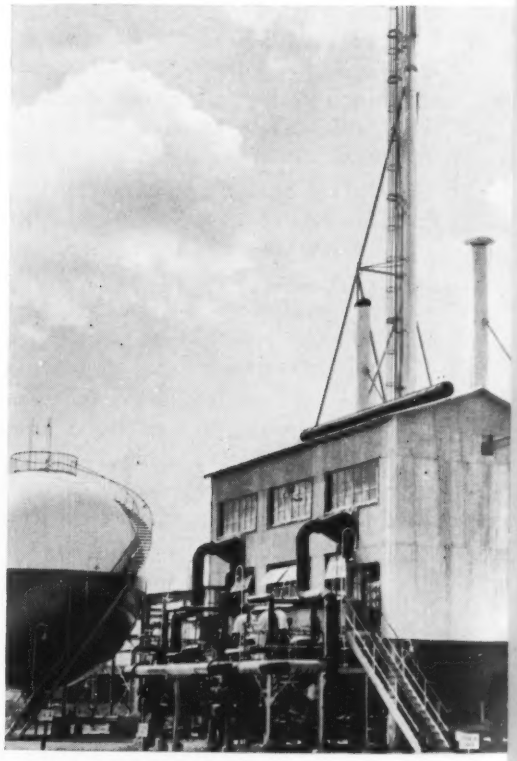
* The other three: Monsanto, Carbide and Carbon, B. F. Goodrich.

A CHEMICAL ENGINEERING **PICTURED FLOWSHEET**

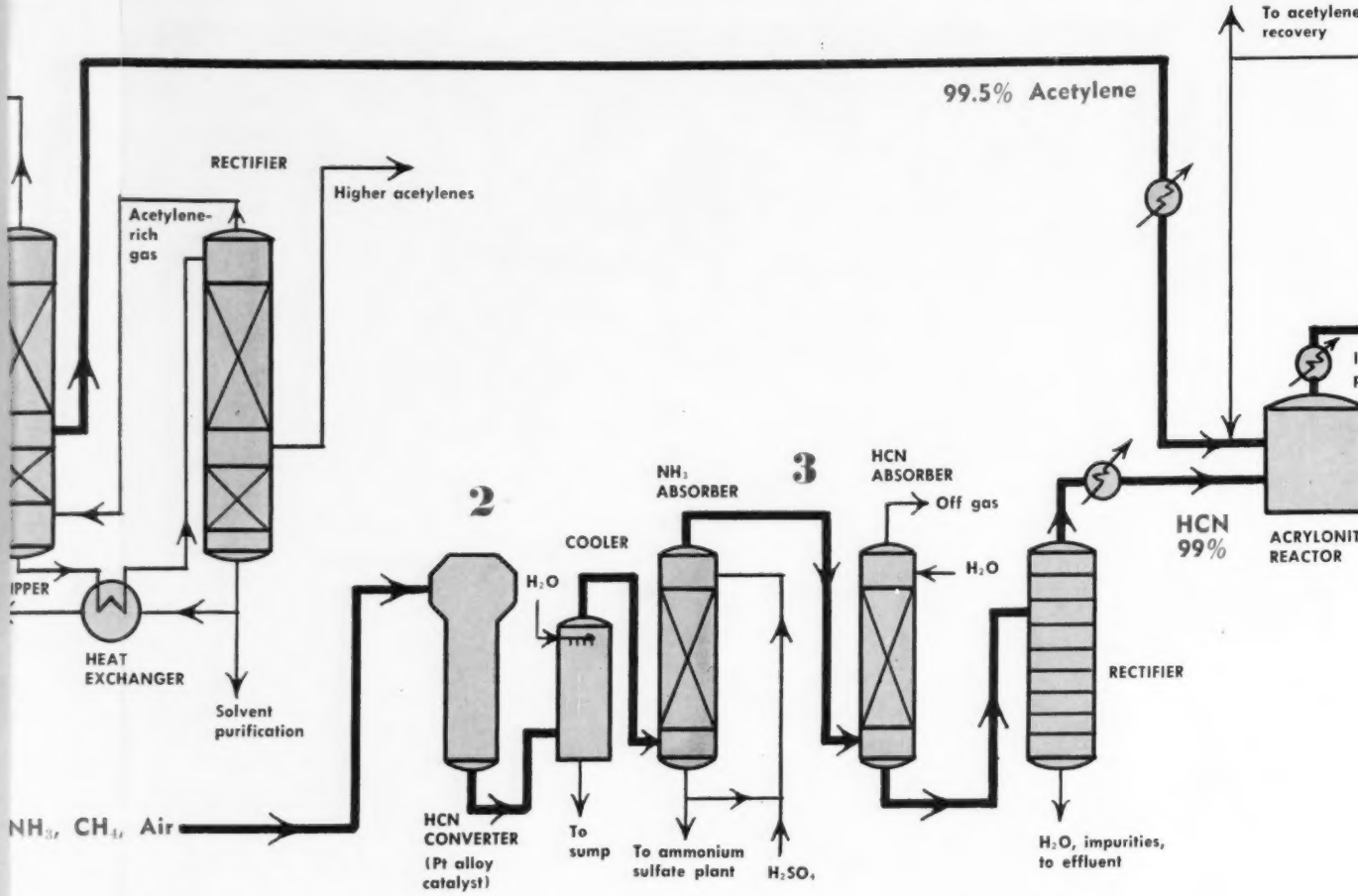


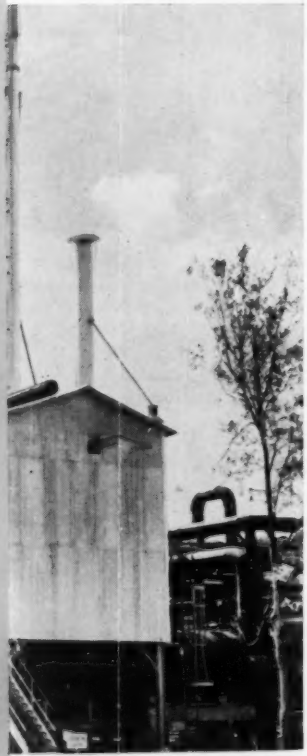


1 **ACETYLENE SYNTHESIS** (foreground) and purification. Sixty ton day unit uses the Badische Anilin & Soda Fabrik process.

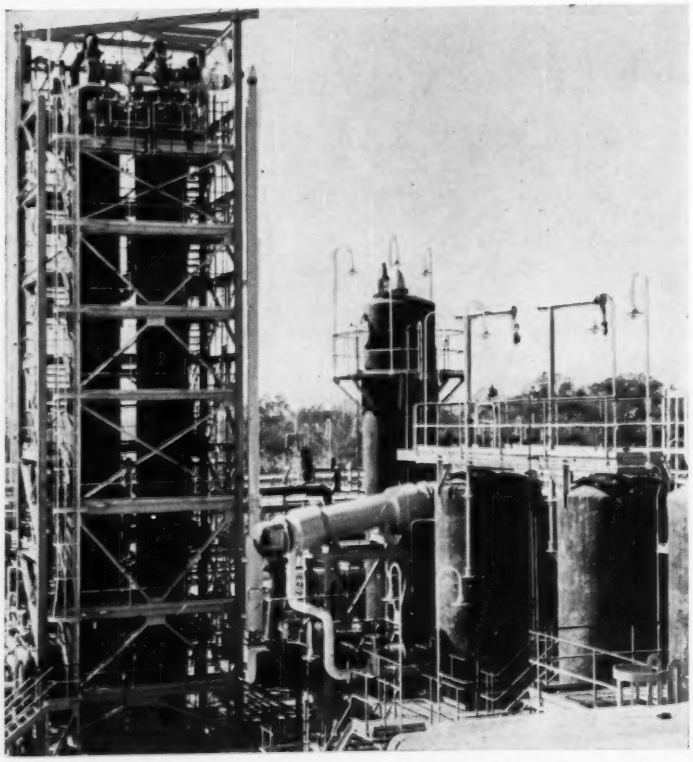


2 **HCN CONVERTERS** are in the covered building. and natural gas react with the aid of a Pt-alloy cata

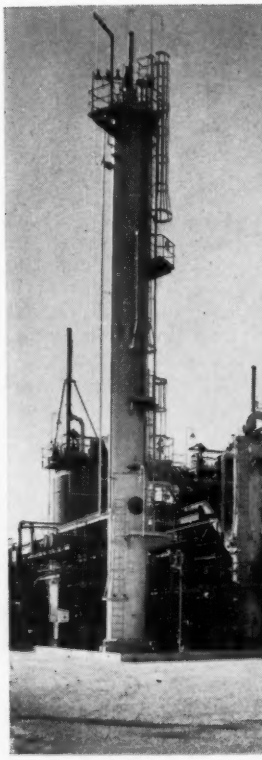




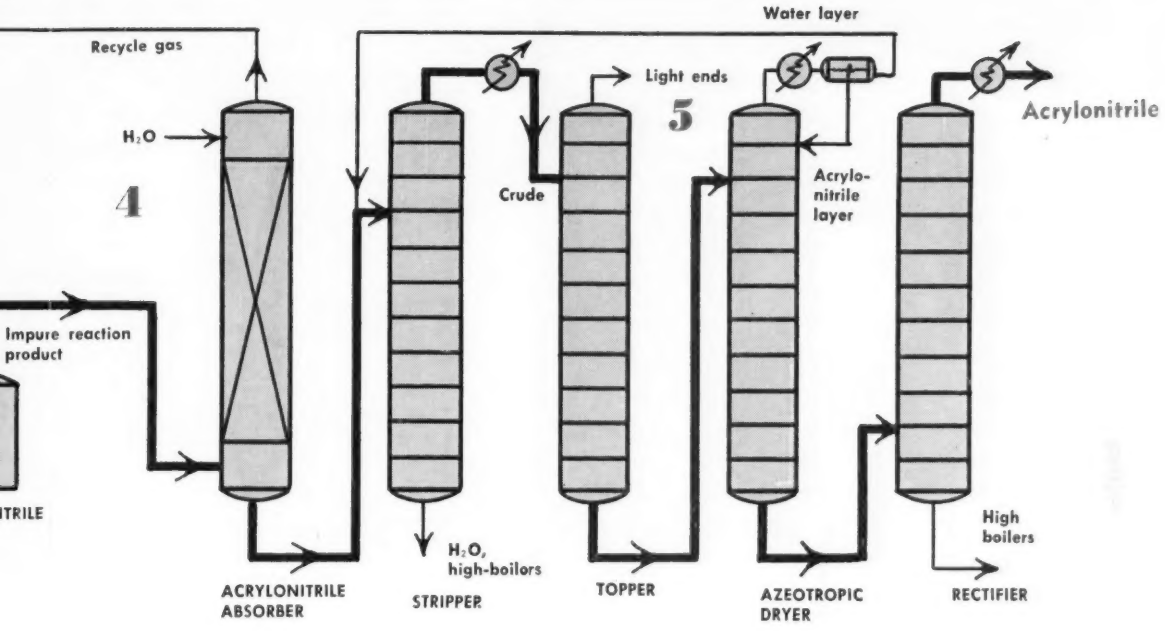
d building. Here ammonia, air
Pt-alloy catalyst.

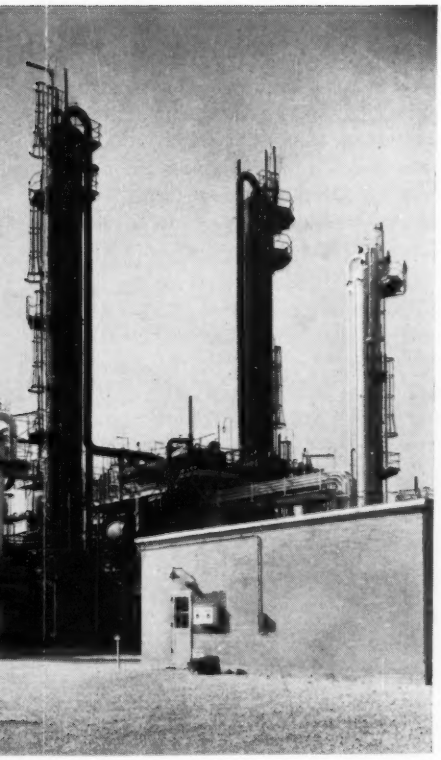


3 HCN PURIFICATION, where ammonia is removed in H_2SO_4. HCN is absorbed in water, then concentrated to 99%.

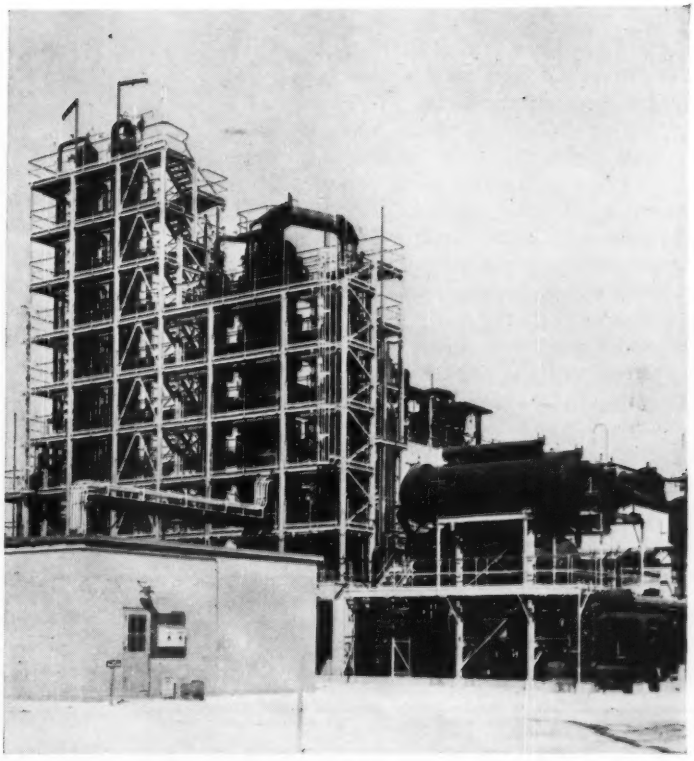


4 ACRYLONITRILE SYN
the foreground. A liquid

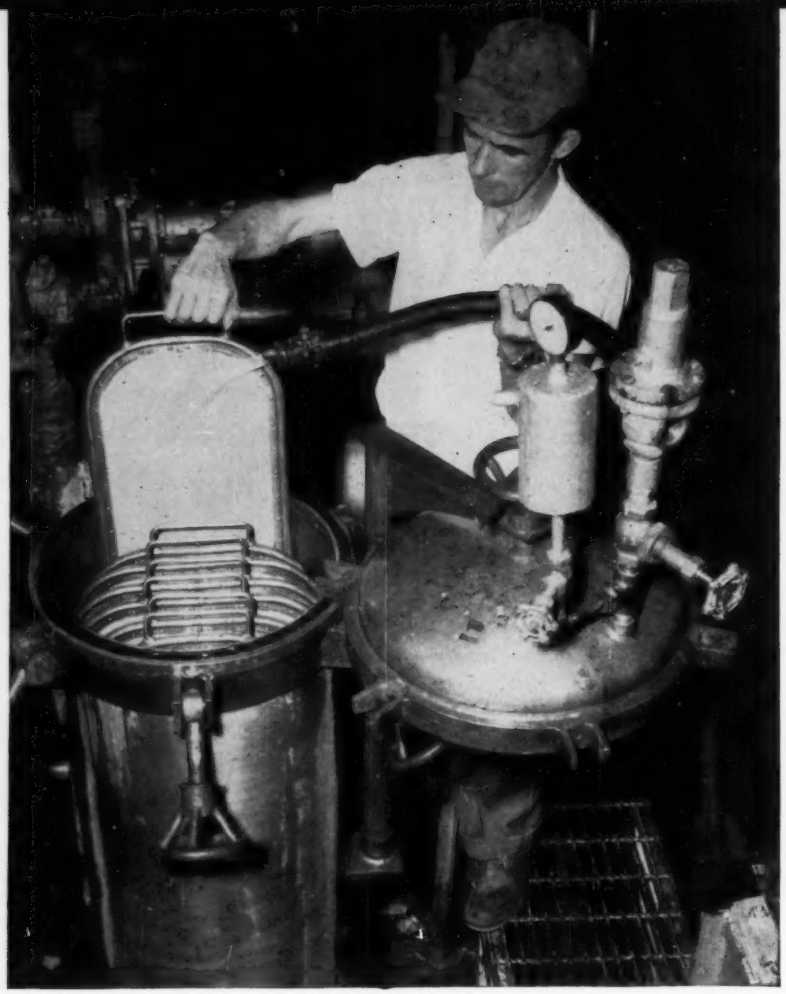




NTHESIS section with concentration towers in phase catalyst is employed.



5 ACRYLONITRILE PURIFICATION. Here, impurities (lactonitrile, HCN, higher acetylenes and cyanobutane) are removed.



This Filter Paid For Itself In ONE MONTH!

After watching a Niagara Vertical Filter in operation at a competitive plant, the Mississippi Chemical Corporation, Yazoo City, Miss., immediately purchased their own unit. It is used for filtering ammonium nitrate solutions for the removal of foreign materials before reprocessing. Unless filtered out, these foreign materials would present a serious explosion hazard. Mississippi Chemical Corporation tells us their Niagara *more* than paid for itself in the *first month* of operation by permitting the salvaging of materials that previously had been sold at a considerable reduction below market price.

W. B. Dunwoody, general operations manager, said: "We are also very pleased with the simplicity of the unit and the ease with which it can be cleaned without interruption to our process." Operating and cleaning a Niagara rarely takes more than part of one man's time—even with several filters in operation. The stainless steel leaves require no cloth bags, so there are none to remove, wash, replace . . . or pay for.

This is no isolated case. Niagara Filters are saving money in hundreds of processing plants handling products running the gamut from aluminum acetate to zinc chloride solutions. Niagaras give positive removal of solids to almost any degree desired—flow rates two to five times greater than those of cloth-covered presses—and no messy floors or fume and drippage loss as they are fully enclosed, vapor tight.

Your Niagara Filter, either vertical or horizontal, can be selected from a wide range of capacities up to 40,000 G.P.M. It can be made of any corrosion-resistant material that can be fabricated by normal shop methods and can be rubber or plastic lined, steel jacketed or insulated. Pressures to 75 PSI are standard but yours can be built for pressures up to 280 PSI—all construction meeting ASME requirements.

For more details on Niagara Filters, mail the coupon today.

Niagara FILTERS

A DIVISION OF

American Machine and Metals, Inc.

DEPT. CE955, EAST MOLINE, ILLINOIS

☐ Send catalog No. NC-1-53 ☐ Have representative call

Name and title_____

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Specialists in Liquid-Solids Separation

These Crane valves stay tight on soap oils and fatty acids

THE CASE HISTORY—Leakage through valve seats in raw materials supply lines posed a serious problem for Davies-Young Soap Co., Dayton—makers of various type soaps and cleaning fluids. Unwanted materials leaking past metering stations would infiltrate processing vats.

Four different makes of valves were tried before these Crane valves were installed. With all four, results were the same—seat leakage developed quickly; the valves lasted no more than 4 to 8 weeks.

Valve replacement costs were a factor on top of production losses.

The condition was remedied on installation of Crane No. 1670 Ni-Resist cast iron valves in January 1954. Eighteen months later—with no piping maintenance and no shutdowns whatsoever—the Crane valves are still holding tight. And they show no deteriorating effects from the fluids handled.

Crane Ni-Resist gates don't *look* much different from similar valves of other makes. Their difference is in properly designed, accurately finished seating of 18-8 SMo stainless steel—plus the *extra* erosion-corrosion resistance of Ni-Resist bodies and bonnets cast by Crane. Thrifty buyers know these valves have no "equal" for handling many hard-to-hold, mildly corrosive fluids.

You should have the new folder (AD2047) on these valves. Ask your Crane Representative for a copy, or write to Crane Co., General Offices, Chicago 5, Ill. Branches and Wholesalers serving all industrial areas.

CRANE CO.

for the THRIFTY BUYER

VALVES · FITTINGS · PIPE
KITCHENS · PLUMBING · HEATING

CRANE'S FIRST CENTURY...1855-1955

SUPERFINE PULVERIZING in the Low Micron Sizes!

Raymond VERTICAL MILL

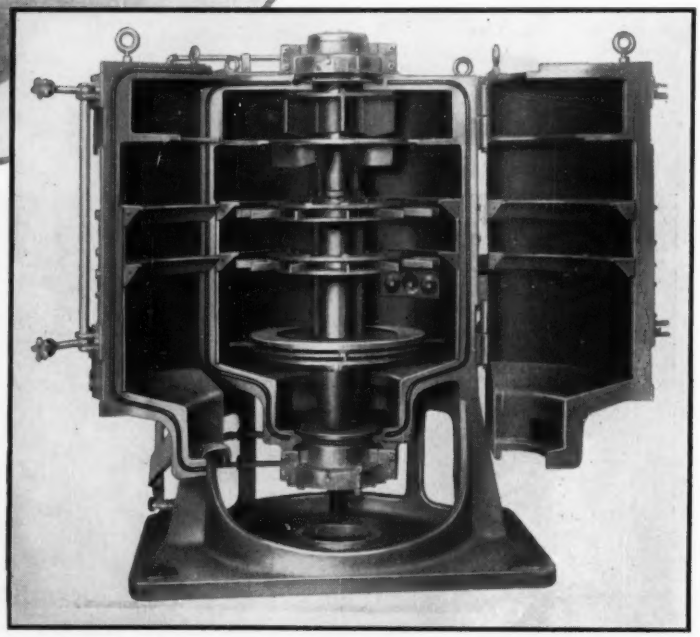
RAYMOND
SINCE 1887

HERE is a practical straight-forward pulverizing unit that has proved its leadership in the high-fineness grinding field for the production of uniform quality powdered materials in sub-sieve particle sizes, testing 90% to 95% finer than 10 to 15 microns in the finished product.

The Vertical Mill is an outstanding Raymond design in ease of operation, simplicity of control and wide-open accessibility to all working parts for inspection, cleaning, adjustment, maintenance. The mill has no close clearances or complicated gimmicks—a precision machine of simple construction.

The operation is clean, dustless and automatic. The mill gives excellent results in producing superfine grades of graphite, cobalt oxide, earth colors, vermiculite, clays, talc, chemicals food products and many similar soft materials.

Write for Raymond Bulletin #70



Hinged Doors open wide for Complete Accessibility

Easy to clean out when changing to different materials. Simple to make adjustments for controlling particle size. Whizzer air separation maintains close uniformity and provides wide range fineness regulation.

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Raymond Division

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Combustion Engineering - Superheater, Ltd., Montreal, Canada.

R. Lindley Murray

Bjarne Klaussen

Hookers Leaders: Men of the Month

Chemical engineers fill positions of board chairman and president of Hooker Electrochemical Co.

The trend toward using engineers to fill chemical industry positions high on the corporate ladder gained new momentum as Hooker Electrochemical Co., long a leader in placing technical men in top jobs, picked two chemical engineers for its most responsible posts.

At a recent meeting of the board of directors, Hooker named R. Lindley Murray, a former national singles tennis champion and company president since 1951, as chairman of the board. At the same time, Bjarne Klaussen, erstwhile executive vice president, was elected president.

▶**West Coaster**–San Francisco-born Lindley Murray did his collegiate work at Stanford University, where his father served for many years as head of the Classics Department. In 1913, he graduated with a BA in chemistry. After a year of post-graduate work, Stanford awarded him the degree of chemical engineer.

While at college he was named to Phi Beta Kappa and Sigma Chi, and for a spell he held the Pacific Coast record for the half-mile run.

But tennis was Lindley's forte at that time. In five out of six years (1914-19) he ranked among the top four players in the country. And in 1917 he licked all-time great Bill Tilden to win the National Single Championship. The following year he fought through a series of tough matches in a successful defense of his crown.

But soon after, despite the earnest beckoning of a career in athletics, he quit "serious" tennis and turned all his energies to his work at Hooker.

After leaving Stanford, he worked for a short time with Western Sugar Refinery and with the Pacific Coast Borax Co. Joining Hooker in 1916 as a research chemist, he helped to run an explosives plant for the government when World War I began.

▶**With Hooker**–At Hooker, Lindley rose through various positions including manager of research, plant superintendent, chief engineer, director of development, vice president in charge of research and development and executive vice president.

Throughout his career, he has been noted for three qualities: friendliness, competence and fairness.

His host of friends in all ranks of industry attest to the first–even those whom he regularly licks with his "in the 80's" golf game. Evidence of his competence includes Hooker's yearly appearance on the roster of companies cited as "excellently managed" by the American Institute of Management–one of very few chemical companies so honored. The company's favorable labor-management relations – featured by low turnover and steady work–and his efforts as a member of the Panel of Arbiters of the American Arbitration Society evince his fairness.

A director or past director of a number of technical, industry and civic organizations, Mr. Murray was Schoellkopf medallist in 1949 and in 1953 he was awarded an honorary membership in the American Institute of Chemists.

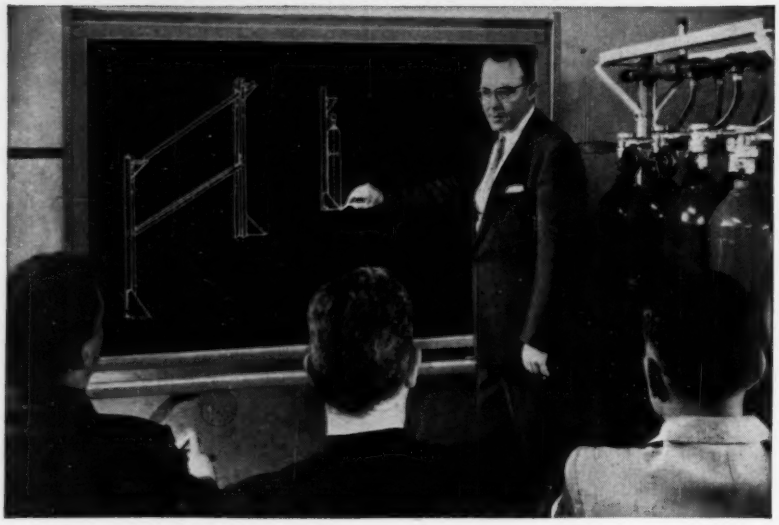
▶**From Norway**–Bjarne Klaussen also started with Hooker in 1916–right after graduating from Norway's University of Oslo. And he, too, began his career as a research chemist.

Except for a 3-yr. stint as manager of technical sales service, he has spent most of his career in production management. After a series of supervisory posts, he became works manager of Hooker's Niagara Falls installation–the company's biggest–in 1941. The following year, he was elected to the board of directors and in 1947 Hooker elevated him to vice president in charge of production.

In 1951, when Klaussen became executive vice president, Hooker was in the throes of readying a $25 million expansion program, greatest in the company's history. This not only added and revamped production facilities, but it was also studded with a merger and other acquisitions.

The Murray-Klaussen duo functioned so smoothly through this period of tremendous growth and

GREATEST FIRE FIGHTING DESIGN ADVANCE IN 25 YEARS!



This Kidde Automatic Pressure-Operated CO_2 Extinguishing System is *brand new from the floor up!*

✓ CHECK THESE 10 FEATURES!

☐ **1. NO FALLING WEIGHTS**—No clumsy mechanical triggering methods. Pneumatic or Electrical Control Heads automatically trigger CO_2 cylinders, assure complete discharge!

☐ **2. SELF-ENCLOSED PARTS**—All moving parts of the new Kidde system are self-enclosed to prevent fouling or accidental operation!

☐ **3. EASIER INSTALLATION**—New racking arrangement is pre-drilled at the factory, eliminates need for special hangers, tools or outside material! Can be either "free standing" or wall mount.

☐ **4. NO PARTS TO REPLACE**—Even after a fire, operating parts of the new Kidde system can be re-set with a screwdriver. No parts need be replaced. Refill cylinders and system is ready for operation!

☐ **5. SIMPLE, THOROUGH TESTING**—By merely disconnecting control heads from cylinders, *all* operating parts (other than actual discharge of CO_2 gas) can be tested *in place!*

☐ **6. QUICK VISUAL INSPECTION**—All primary actuating parts fitted with easy-to-read visual indicator. Shows at a glance if system is "set" or "released."

☐ **7. MULTIPLE PROTECTION**—Automatically-operated Directional Valves let you protect more than one hazard from the same bank of cylinders!

☐ **8. SIMPLIFIED WEIGHING**—New racking arrangement lets you weigh CO_2 cylinders right in place without disconnecting them, providing uninterrupted fire protection even while cylinders are being weighed!

☐ **9. NO OUTSIDE POWER NEEDED**—The new Kidde system is completely self-contained, has rate-of-temperature-rise detectors which give sure protection even in case of outside power failure!

☐ **10. AUXILIARY EQUIPMENT**—Also available for use with the new Kidde system are devices for turning power on or off, for opening or closing doors, windows, dampers, etc.

Fully approved by Underwriters' and Factory Mutual Laboratories.

Complete details of this revolutionary new system are contained in Kidde's Pressure-Operated System Booklet. Write for your copy today!

Kidde (K Kidde) **Walter Kidde & Company, Inc.**
928 Main Street, Belleville 9, N. J.

Walter Kidde & Company of Canada, Ltd., Montreal—Toronto

The words 'Kidde', 'Lux', 'Lux-O-Matic', 'Fyre-Freez' and the Kidde seal are trademarks of Walter Kidde & Company, Inc

NAMES . . .

growing pains that Hooker also used this time to introduce several new products and cop the aforementioned AIM honors.

▶**Artist and Civic Leader**—Klaussen's major hobby, modern painting, has won him many prizes and honors. His work has even been featured in national magazines along with that of such art luminaries as Sir Winston Churchill and Grandma Moses.

In addition, he holds office in a number of civic groups and has served as president of the Niagara Falls Community Chest and of the Rotary Club.

Although he became a U. S. citizen in 1926, Mr. Klaussen has been Royal Norwegian Vice-Consul for many years. In recognition of his service, Norway's King Haakon personally conferred the honorary decoration of the Knight's Cross, First Class, of the Royal Order of Saint Olav on him last year.

Mr. and Mrs. Murray and Mr. and Mrs. Klaussen are also neighbors in Lewiston, N. Y., a suburb of Niagara Falls.—HTS

W. K. MacCready—Manager of manufacturing for the General Electric Co. at the Hanford, Wash., plant.

Lawrence R. Hafstad—Director of General Motors' research staff. Dr. Hafstad has been director of the atomic energy division, Chase Manhattan Bank, N. Y., and previously was director of the Atomic Energy Commission's division of reactor development.

Hubert C. Snowden—General superintendent, southern division, Consolidated Chemical Co., replacing **J. C. Crowder,** who moves to San Francisco headquarters as vice prescident and general manager of West Coast and East Coast glue operations. **O. D. Massey** succeeds Mr. Snowden as manager of the Houston, Tex., plant and he is replaced by **J. A. D. Todd** as plant manager in Fort Worth, Tex.

Gordon P. Larson—Resigned as di-

rector of research and engineering of Los Angeles County's air pollution control district.

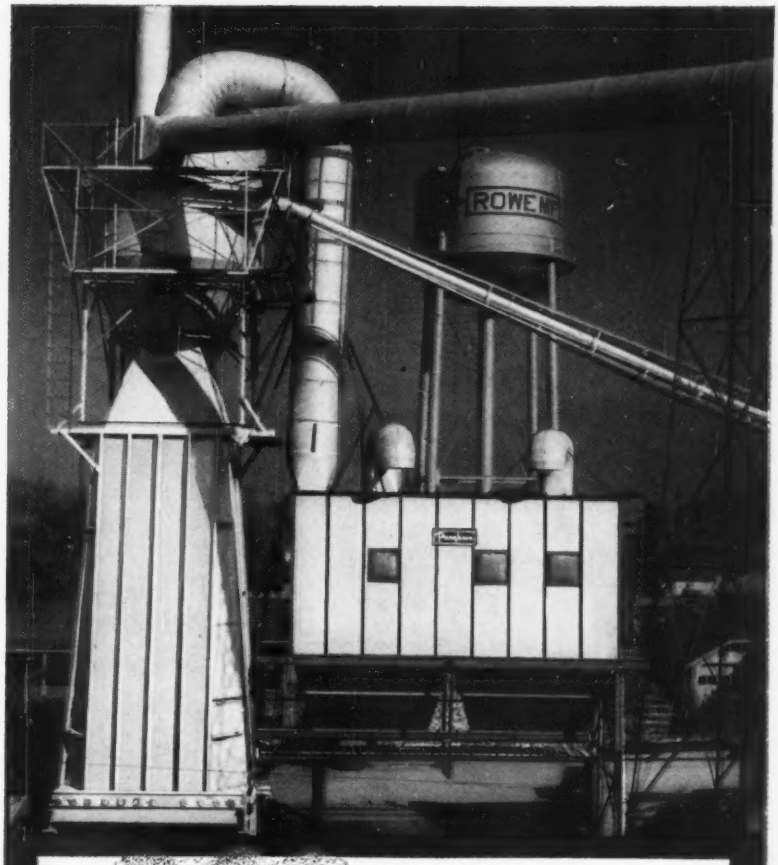
William C. Foster

Mr. Foster, former Deputy Secretary of Defense and president of the Manufacturing Chemists' Association, Inc., is now an executive vice president of Olin Mathieson Chemical Corp. He had completed nearly 11 years of government service when he resigned as Deputy Secretary of Defense in 1953, to become MCA's first full time president. Previously Mr. Foster served as head of the Marshall Plan with cabinet rank and the title of Administrator for Economic Cooperation; Under Secretary of Commerce; Deputy U. S. Special Representative in Europe for ECA, with the rank of Ambassador Extraordinary and Plenipotentiary and Deputy Administrator of ECA.

Anthony Anable—Resigned as director of governmental and community relations of Dorr-Oliver Inc., Stamford, Conn., Mr. Anable will serve as director of public relations for the United Fund of Stamford, Inc., until the conclusion of the campaign this fall.

Joseph G. Davidson—Chosen to receive the Chemical Industry Medal for 1955 "for conspicuous services to applied chemistry." Mr. Davidson is vice president of Union Carbide and Carbon Corp.

Paul Weber—Appointed Dean of



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Pangborn Dust Control saves Rowe over $12,000 a year in heating costs

Dust used to "make it hot" for Rowe Manufacturing Co., Galesburg, Ill., by posing a serious problem. Rowe, a large producer of wood products (like the Ro-Way garage door), was troubled by the great volume of dust created by its many woodworking operations. Today dust makes it hot for Rowe in a different way! Thanks to Pangborn Dust Control, collected dust now fuels the boilers that provide steam for power and heat. The dust collected by Pangborn Dust Control saves Rowe over $12,000 in heating costs annually! In addition, Pangborn has improved community relations, employee relations and plant cleanliness.

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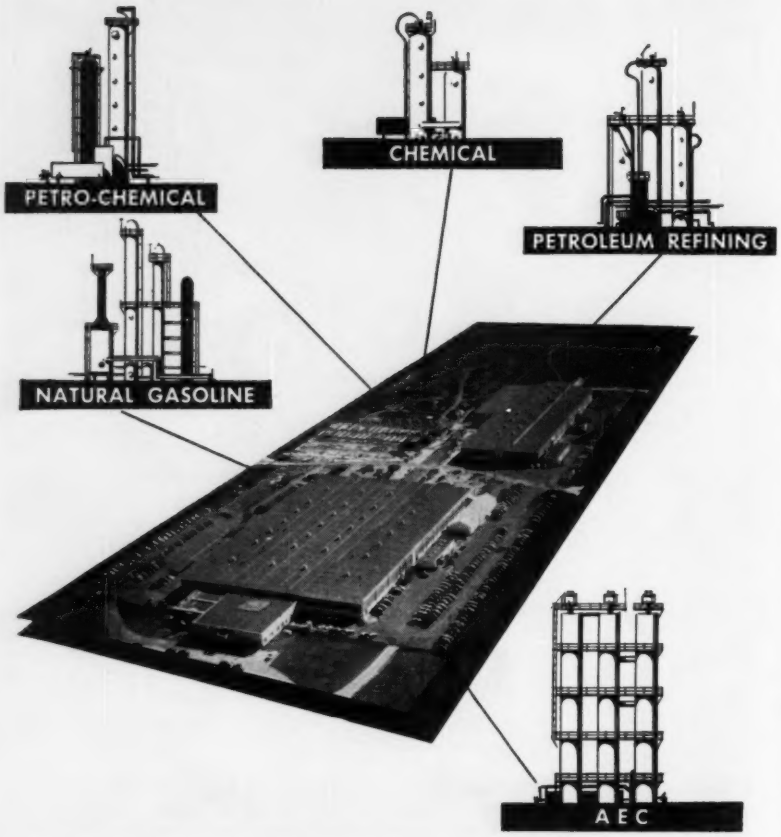

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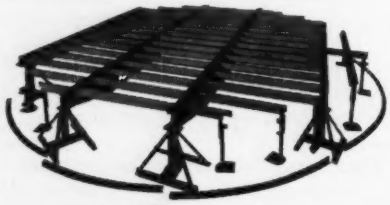

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NAMES . . .

Faculties at Georgia Institute of Technology. Dr. Weber was formerly professor of chemical engineering and director of the institute's school of chemical engineering. In his new position, he shall be in administrative and executive charge of the engineering college; general college; graduate division; army, navy and air force ROTC units and the cooperative division.

Norman A. Shepard—Retired from his post as chemical director of American Cyanamid Co. Cyanamid's market research and new product development departments have been consolidated, the combined organization reporting to **Borden R. Putnam, Jr.**, manager of market development. **Samuel D. Koonce** is manager of the market research department, **James G. Affleck** is manager of the new product development department.

J. A. Bartlett—President of American Mineral Spirits Co., succeeding **M. A. Williams,** resigned.

James H. Jensen—Advisory engineer at American Potash & Chemical Corp.'s main plant, Trona, Calif.

Gerald S. Tomkins—Elected president of American Viscose Corp.

Harold V. Lee—Vice president in charge of G. Barr and Co.'s New York City plant.

Rex E. Lidov—Appointed research associate in the research department of Brea Chemicals, Inc., subsidiary of Union Oil Co. of Calif.

Milton R. Wingard—Project engineer, fats and oils department, Blaw-Knox Co.

A. E. Harold Fair—President of Brown Co., pulp and paper manufacturers.

Margaret H. Hutchinson—Recipient of the annual award of the Society of Women Engineers for

"outstanding achievement in engineering," presented at the society's annual award dinner in Hollywood, Calif., June 25. Dr. Hutchinson, of Stone & Webster Corp., is the only woman holding active membership in the American Institute of Chemical Engineers.

J. Emmett Maider, Jr.

Mr. Maider, former manager of manufacturing for the General Electric Co., at the Hanford plant it operates for the Atomic Energy Commission, is the new manager of the Commonwealth Edison project, Schenectady, N. Y. (G. E. is prime contractor to Commonwealth Edison for construction of a $45 million atomic power reactor in Illinois.) He jointed Du Pont in 1938, then was transferred to the Hanford works in 1945. Maider was named manager of the production section in the manufacturing department in 1950 and department manager in 1953.

Harold J. Egan–President of Can-Amera Oil Sands Development Ltd., succeeding **Stanley M. Paulson.**

H. Percival Chase–Appointed vice president of C.M.C. Chemicals (Calif.) Inc., Los Angeles. Mr. Chase was formerly vice president of Mefford Chemical Co.

Nicholas Weber–Elected vice president in charge of all engineering activities by Condenser Service & Engineering Co., Inc., Hoboken, N. J.

F. Carroll Stille–Vice president of

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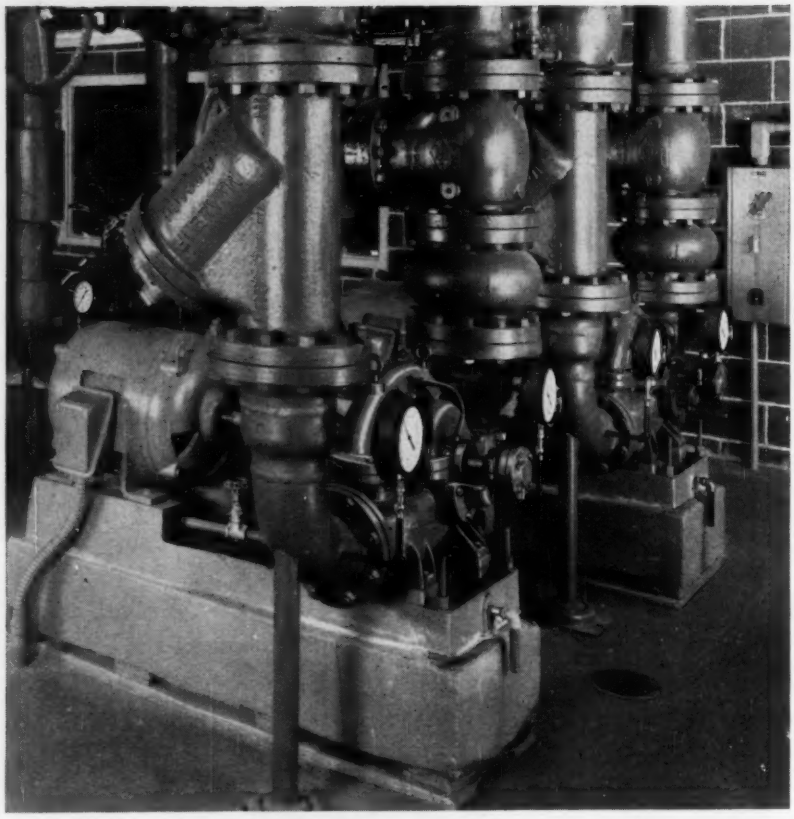

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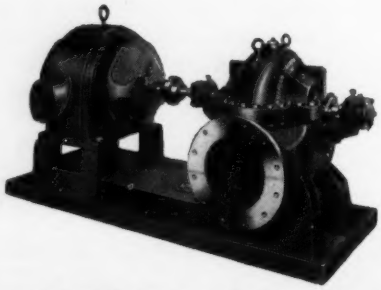

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NAMES . . .

Corhill Corp., erectors of power and process piping.

S. G. Sevougian—Appointed manager of the Framingham, Mass., plant of Dow Chemical Co. **J. C. Webb** and **R. F. Winston** have been promoted to positions as engineering group leaders in the company's engineering department. **W. S. Chenault** is the new superintendent of the company's soda ash plant in Freeport, Tex.

Miles A. Dahlen—Named winner of the 1955 Olney Medal, highest award of the American Association of Textile Chemists and Colorists, presented for "outstanding achievement in the field of textile chemistry." Dr. Dahlen is adviser on dyes, intermediates and related chemicals in the technical division of the organic chemicals department, E. I. du Pont de Nemours & Co., Inc.

Abraham Smaardyk—Appointed associate director of the nuclear engineering department at Edward Valves, Inc., subsidiary of Rockwell Mfg. Co.

L. R. Modlin, Jr.—Named manager of general chemicals sales, B. F. Goodrich Co. **J. S. Wolff** succeeds Mr. Modlin as field sales manager for the general chemical sales department.

J. F. Kerscher—Named to head the newly formed rubber compounding section in the chemical materials development department of Goodyear Tire & Rubber Co., Inc.

Frederick C. Kroft—Appointed general superintendent of manufacturing for Haynes Stellite Co., a Division of Union Carbide and Carbon Corp.

Harry W. Watson—Manager of Hercules Powder Co.'s Hattiesburg, Miss., plant, succeeding **L. Coleman Hall,** retired.

Norman Bedziner and **William E. Kreiner**—Members of the process

study group of Hooker Electrochemical Co., Niagara Falls, N. Y.

Theodore A. Burtis—Associate manager of research and development at Houdry Process Corp.'s laboratories in Linwood, Pa. **Julius J. Cicalese** succeeds Mr. Burtis as supervisor of process engineering.

Richard F. Shaffer

Mr. Shaffer, former professor and chairman of the chemical engineering department of Pratt Institute, Brooklyn, has been appointed vice president in charge of manufacturing and a member of the board of directors of the Schlegel Lithographing Corp., New York, N. Y. He has been active in the field of graphic arts as a consultant to many firms in the New York area and has also conducted, for the last six years, a course, "Lithographic Processes and Materials," at the New York University Graphic Arts Center. Mr. Shaffer is past chairman of the New York Section, American Institute of Chemical Engineers.

James W. Foley—Named executive vice president of the Texas Co.

William L. Napoli—Named lubrication engineer for Tide Water Associated Oil Co.'s eastern division export sales department.

Herbert J. Reid—Appointed assistant general manager of the mechanical goods division, U. S. Rubber Co.

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NAMES . . .

Albert J. Gerathy—In charge of production, purchasing and coordination of new product development for Carter Products, Inc. Mr. Gerathy was former production chief at Warner-Hudnut.

Ivor R. Burden—Vice president and general manager, Heckathorn & Co., United Chemical Co. and United Fertilizer Co.

Leslie R. Hamilton—Coordinator of fertilizer operations for California Spray-Chemical Corp., Richmond, Calif. **Frank J. Juchter** is manager of the company's manufacturing department.

E. W. Adams—Plant manager of Kaiser Aluminum & Chemical Corp.'s new basic refractory brick plant, soon to be constructed at Columbiana, Ohio.

Jesse Coates—Head of the department of chemical engineering, Louisiana State University and Agricultural and Mechanical College.

Harry Stanley Rogers—Elected a member of the board of directors, McGraw-Hill Publishing Co. Dr. Rogers is president of the Polytechnic Institute of Brooklyn.

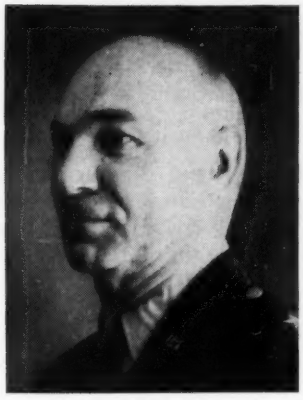
Joseph W. Barker—Nominated to serve as the next president of the American Society of Mechanical Engineers. Mr. Barker is chairman and president of the Research Corp.

Louis H. Roddis, Jr.—Deputy director of the division of reactor development, Atomic Energy Commission. **Frank K. Pittman** is deputy director of the commission's division of licensing

W. H. Zinn—First president of the American Nuclear Society. Dr. Zinn is director of the Atomic Energy Commission's Argonne National Laboratory, Lemont, Ill.

John R. Hoover—Chairman of the board of directors of the Manu-

facturing Chemists' Association, Inc. Mr. Hoover, president of B. F. Goodrich Chemical Co., succeeds **Fred J. Emmerich,** president of Allied Chemical and Dye Corp.



Clifford L. Sayre

Clifford L. Sayre, development chemical engineer for Becco Chemical Division and other chemical divisions of Food Machinery and Chemical Corp., has been appointed brigadier general, U. S. Chemical Corps Reserve. He becomes the first reserve officer to attain the rank of general in the Chemical Corps. General Sayre's mobilization assignment is deputy assistant chief chemical officer for chemical warfare, research and development.

George M. Dreher—Appointed supervisor-chemical services for Jones & Laughlin Steel Corp., succeeding **Carl F. Allison,** retired.

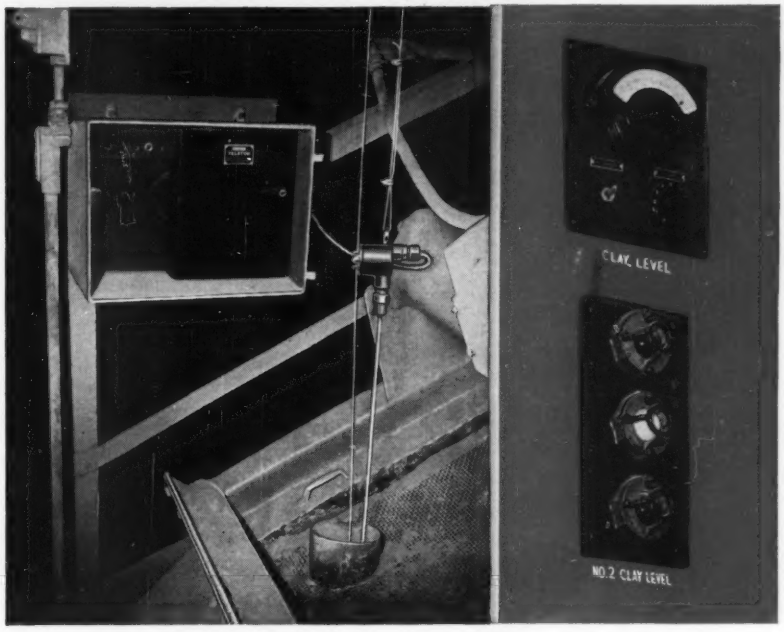
John A. Jost—Heat exchanger development engineer with Kewanee-Ross Corp (Ross Heater Division), Buffalo, N. Y., after 18 years with Foster-Wheeler Corp.

A. Richard Dahlem—Assistant superintendent of the roll film division, Kodak Park works.

Walter C. Rueckel—Elected vice president and general manager, engineering and construction division, Koppers Co., Inc.

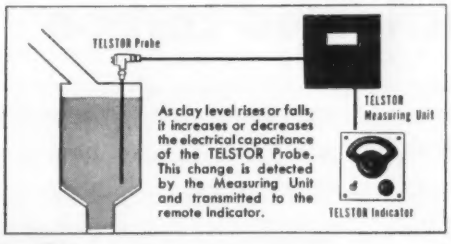
J. R. Durland and **R. S. Wobus**—

At Magnolia Petroleum TELSTOR Saves Operator Time and Clay



A Fielden TELSTOR System now enables operators at Magnolia Petroleum Co., Beaumont, Texas, to keep tabs on spent clay as it flows from a lube oil filter to a storage hopper to a revivifying kiln.

Because of its ability to measure all types of material and catalysts, TELSTOR shows clay level in the hopper with good accuracy. Its simple and completely safe electronic system is unaffected by the clogging nature of the oil-saturated clay. Send the coupon today for more facts about TELSTOR.


TELSTOR Probe
As clay level rises or falls, it increases or decreases the electrical capacitance of the TELSTOR Probe. This change is detected by the Measuring Unit and transmitted to the remote Indicator.
TELSTOR Measuring Unit
TELSTOR Indicator

TELSTOR Features

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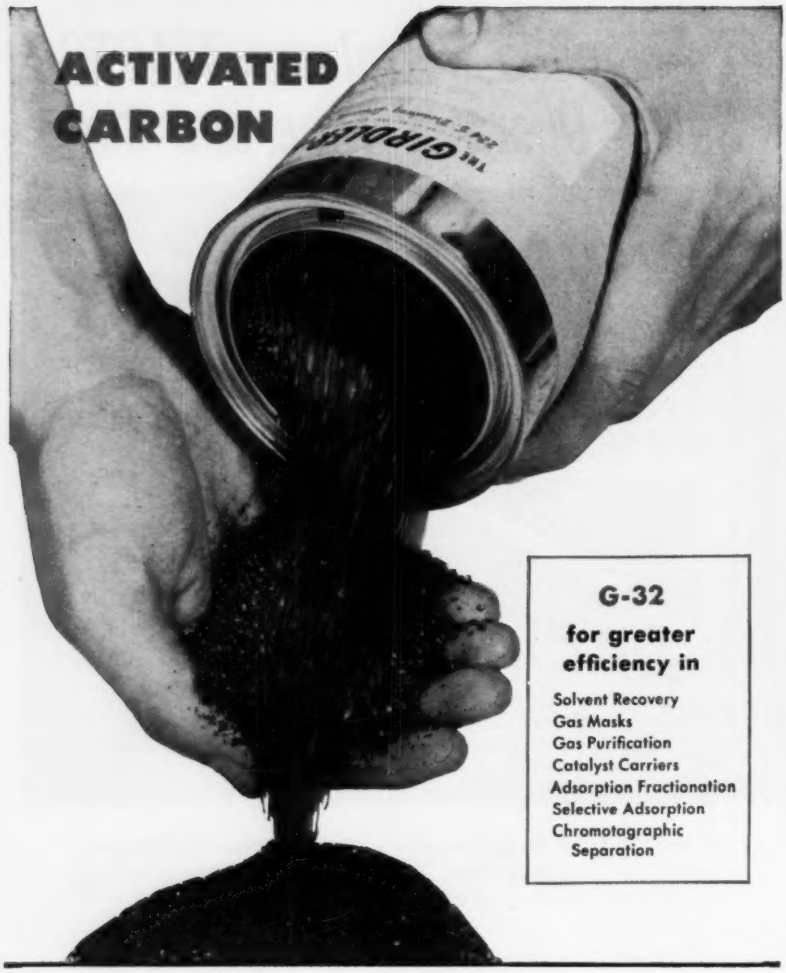

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NAMES . . .

promoted to the newly created positions of technical production managers, Monsanto Chemical Co.'s organic chemicals division. **John C. Garrels** has assumed the position of assistant general manager in charge of manufacturing of the company's plastics division. **Paul Stahlberg** has been appointed technical service manager for the polyethylene resins department of the plastics division.

Loren J. Sewall—Promoted to factory superintendent of Minnesota Rubber and Gasket Co. **Arthur B. Warner** is the firm's chief engineer.

John W. Nixon—Appointed plant manager for the National Petro-Chemicals Corp. operation at Tuscola, Ill. **Charles D. Carnes** is chief engineer.

George B. Beitzel—Retired as president of the Pennsylvania Salt Mfg. Co. Mr. Beitzel continues to serve as a member of the board and is the chairman of the board of Pennsalt International Corp. **James McWhirter** has been named manager of manufacturing for Pennsalt.

George W. Taylor—Appointed chemical research engineer in the special applications department of the Permutit Co.

William K. Whiteford—Elected a director of Procter & Gamble. Mr. Whiteford is president of the Gulf Oil Corp.

William L. Walsh—Elected president of the Quebec Iron and Titanium Corp., which is two-thirds owned by Kennecott Copper Corp. and one-third by the New Jersey Zinc Co. Mr. Walsh had previously been associated with General Aniline & Film Corp.

Warren Stubblebine—Appointed director of research and development by Stowe-Woodward, Inc., rubber roll specialists at Newton, Mass.

Elwood I. Lentz—Appointed general manager of Western Phosphates, Inc., Garfield, Utah.

OBITUARIES

Patrick Henry McCarthy, 86, founder of the Vulcan Stamping & Mfg. Co., Vulcan Tin Can Co., died June 10.

F. D. Oldham, head of the chemical engineering department at the University of Missouri, died June 17.

Francis I. Markson, 48, executive assistant manager of Allan A. Wood, Inc., Division of B-I-F Industries, Inc., died June 18 at his home in Highland Park, Pa.

David Burnett Scott, for 18 years western sales manager for American Potash & Chemical Corp. until his retirement in 1952, died of a heart attack on June 20 at his home in Altadena, Calif.

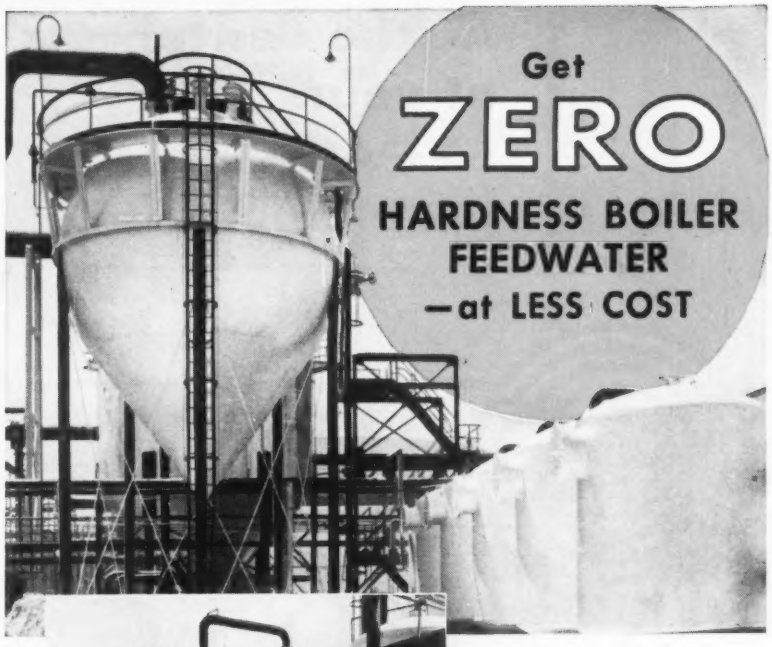
Edwin A. Russell, vice president and director of the Philadelphia Quartz Co., died June 27 in Mt. Holly, N. J., following a heart attack. He was 66 years old.

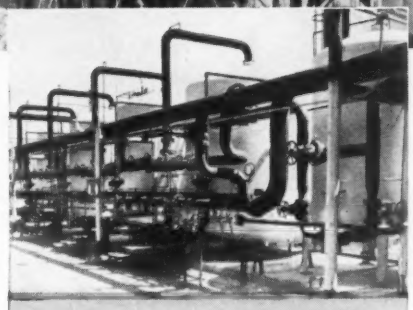
Thomas B. Chadwick, 58, senior salesman of Chas Pfizer and Co.'s chemical sales division, died suddenly at his home in Lakewood, Ohio, on June 28.

Joseph H. Rockett, 47, assistant sales manager of Sinclair Chemisals, Inc., subsidiary of Sinclair Oil Corp., died suddenly on June 29 at his home in New York City.

James O. Smith, 57, sales represenative of the organic chemicals division, North American Cyanamid, Ltd., was killed in an automobile accident at Markham, Ont., on June 30.

Wendell M. Latimer, 62, professor of chemistry at the University of California and associate director of the university's radiation laboratory, died July 6 following a heart attack.





Top photo shows new outdoor hot lime-zeolite softener installation in a Southern refinery. Five Nalcite HCR ion exchange units (lower photo) have output of 470,000 gallons of zero hardness water between regenerations.

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● Start with the simplicity of operation . . . add the low operating costs of hot lime-zeolite softening . . . all made possible by the outstanding high-temperature performance of Nalcite HCR in the zeolite softeners. Results: Zero hardness water, from virtually any raw water source, with a minimum of testing and control required. See your water treating equipment manufacturer for details on new or conversion hot lime-zeolite treatment for your plant . . . and for top softener efficiency, specify Nalcite HCR.

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THIS MONTH'S

Technical

A Natural Product Industry

CHEMISTRY AND CHEMICAL TECHNOLOGY OF COTTON. Edited by Kyle Ward, Jr. Interscience Publishers, New York. 801 pages. $20.

Reviewed by G. E. Goheen

Editor Ward brings together in one volume the experience and knowledge of many technical and scientific experts in the field of cotton, including fundamental as well as practical aspects.

After presenting an excellent survey of the chemistry, including important chemical and physical properties, of lint cotton by John D. Guthrie and Carl M. Conrad, such processing treatments as sizing, bleaching, dyeing and printing are discussed by F. G. La Piana, E. I. Valko, R. E. Rupp and A. E. Hirst, as representatives of industry. Of special interest to chemical engineers are descriptions of equipment and apparatus arrangements for these operations. However, for the most part, the discussions deal with chemical and textile technology rather than mechanical specifications and statistics.

Special treatments covered in subsequent chapters comprise mercerization by C. F. Goldthwait, water-resistant treatments by H. A. Schuyten, fire resistance by J. W. Church and S. Coppick, and protection against mildew and rot by G. A. Greathouse and C. J. Wessel. Also, D. H. Powers depicts the use of resins for creaseproofing, shrinkproofing, glazing and embossing cotton fabrics. While many commercial applications of cotton are included in the above chapters, a specific discussion of the treatment of cotton for the rubber industry is presented in Chapter XI by E. T. Lessig, M. W. Wilson and H. C. Hebden.

The testing and evaluation of cotton textiles is thoroughly covered by R. K. Worner, while the laundering of cotton fabrics is fully described by J. F. Oesterling. In

Bookshelf

L. B. Pope

the final chapter some important chemical changes encountered in cotton fabrics under processing and service conditions are discussed by J. D. Dean.

The inclusion of a 16-page glossary as well as a comprehensive subject and author index enhances the value of this book as a reference work and adds to its acceptance on the part of the student. The book fills a definite need in a natural product industry which is rapidly making progress through chemistry to overcome the competition of synthetic fibers.

Free Enterprise

FIFTY-FIVE COLORFUL YEARS. The Story of Paint in America. By Ernest T. Trigg, with an Introduction by Dr. Archibald Rutledge. The Pequot Press, Stonington, Conn. 307 pages. $5.

Reviewed by H. C. Parmelee

Few men can record a lifetime spent in a single industry. And still fewer receive the acclaim of their fellows for leading, guiding, and molding that industry out of its swaddling clothes into the garments of maturity. But by common consent Ernest T. Trigg bears that relation to the paint industry. His autobiography is a record of more than half a century of singleness of purpose and wholehearted devotion that is unique in the annals of American industry. His accomplishment is also a tribute to an American's freedom to apply his talents where he will, and to success of what we call free enterprise in American business. It should be emphasized that this story could not have been written in the blighting atmosphere of a totalitarian country. And it is a safe bet that no such country has a paint industry (or any other) to compare with the one that has grown up in the United States under the principles of competi-

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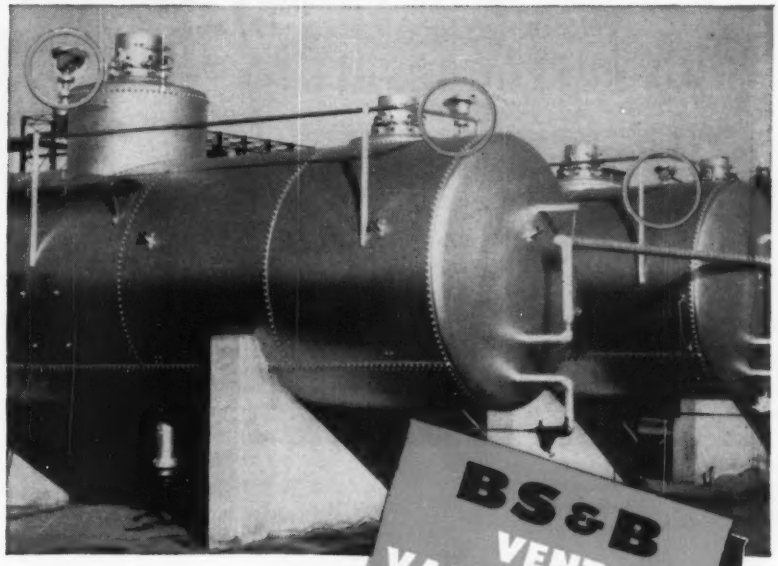

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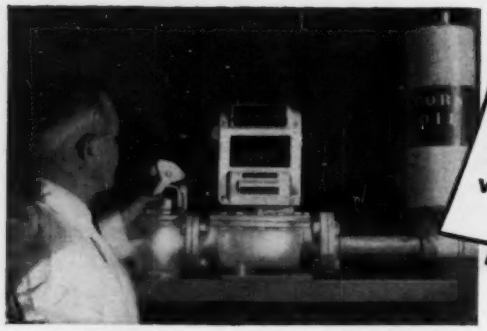

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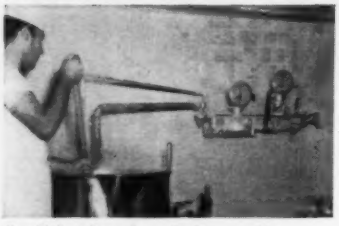

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tion and cooperation espoused and fostered by Mr. Trigg.

He confesses to getting "paint in his eye" on his first job; and his interest and devotion carried him from office boy to the highest offices and honors within the gift of the industry. His initiative, capacity for organization, high sense of industrial ethics, and faith in the industry commended him over and over again to his associates who entrusted him with leadership. One or two examples will reveal the man and his work.

In 1926 paint and varnish manufacturers, who had previously had separate trade associations, formed the American Paint and Varnish Manufacturers' Association. Mr. Trigg became chairman of the Educational Bureau. And it fell to his lot in 1932, when the New Deal took over the government, to anticipate and prepare for the National Recovery Administration. He promptly advocated consolidation of all national paint organizations into one effective body with a full-time paid president. He also proposed immediate preparation of a code of fair practice for the paint industry. Far from resenting and resisting the imposition of a code, as did many other industrialists, Mr. Trigg felt that the NRA held promise of benefits to the national economy and to the paint industry. His recommendations were adopted. A merger was effected between the two principal trade associations of the industry, and Mr. Trigg found himself president of the National Paint, Varnish and Lacquer Association. He was also made chairman of the committee to draft a code for the industry, and it was due largely to his skill in negotiation that a workable code was adopted and supported. Any industrialist who went through that era will appreciate Mr. Trigg's accomplishment.

His flair for organization, coordination, and management made his trade association a model for others. Trade associations were not in too good standing in those days on account of their illegal activities, but Mr. Trigg's organization received the commendation of Mr.

Hoover, then Secretary of Commerce. When he learned of its work he said: "The problem is to get the same type of cooperation in all industries. . . . If the rest could be gotten to imitate it, we should have a tremendous constructive force at work." The same spirit of cooperation to which Mr. Hoover referred enabled Mr. Trigg and his War Service Committee to carry the paint industry through two world wars in the best interests of the government, the industry, and the public. Later, although it taxed his patience and wisdom to the utmost, he weathered the postwar confusion created by the Office of Price Administration.

During his leadership of the industry Mr. Trigg witnessed vast changes in products and processes. The industry shifted from rule-of-thumb procedure to a scientific basis of manufacture. It conducted collective campaigns of advertising and public education that were previously impossible. Notable was the widespread slogan "Save the Surface and You Save All," and the "Clean-up . . . Paint-up . . . Fix-up" campaign that captured public imagination from coast to coast.

Busy and effective as he was in the paint industry, Mr. Trigg found time and energy for numerous civic, educational, and religious activities. In Philadelphia he was president of the Chamber of Commerce, and a director of the Chamber of Commerce of the United States in Washington. President Harding appointed him a member of an unemployment conference under the direction of Mr. Hoover. When the Federal Home Loan Bank system was established, Mr. Trigg was appointed a director and chairman of the board of the bank at Pittsburgh. As chairman of the Industrial Relations Committee of the Philadelphia Chamber of Commerce, he was a vital factor in a back-to-religion movement designed to strengthen the spiritual life of the community. Temple University and Mercersburg Academy both enlisted his sympathetic interest, and he served on their governing boards. Probably his

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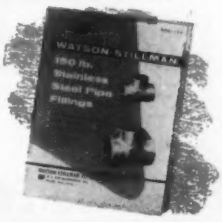

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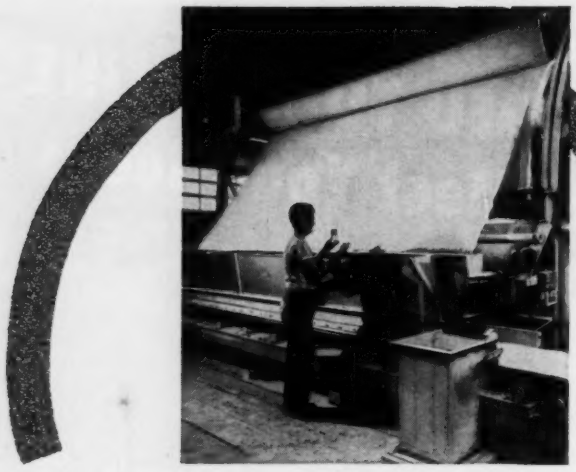

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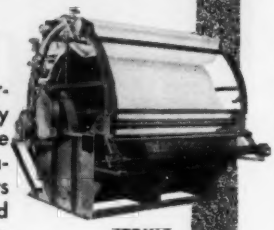

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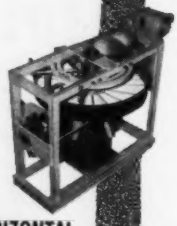

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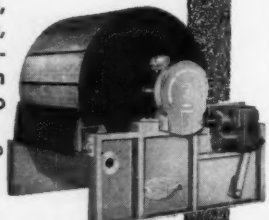

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BOOKSHELF . . .

most important position of public trust is with the Board of Directors of City Trusts, Philadelphia, which administers eighty-seven legacies to the city of Philadelphia. In retirement from active work in the paint industry since 1947, Mr. Trigg devotes much of his time to the City Trusts, but his associates provided a sustaining interest in his life's work by electing him to the office of Honorary Chairman of the Executive Committee of the trade association of the paint industry.

In bringing this biography to public attention, the publishers have rendered service to a better understanding of the American economy. The book shows, as nothing else could, what makes American industry tick!

Elementary

THERMODYNAMICS. By Ray L. Sweigert & Mario J. Goglia. Ronald Press, New York. 355 pages.

Reviewed by R. J. Sweeney

This undergraduate text is intended for junior students, primarily in mechanical engineering. The treatment is introductory to the science of engineering thermodynamics, and applications are not discussed exhaustively.

The first two laws of thermodynamics are covered in the early chapters, followed by the perfect gas properties and processes, gas dynamics, real gases, vapors and mixtures, a discussion of chemical thermodynamics adequate for combustion problems and a final chapter on applications.

The general style is clear and precise. The reader is treated in a rather adult fashion, with full reliance on the proficiency in mathematics and physics expected of a junior engineering student.

The gas dynamics chapter is an adequate treatment of the case of steady one-dimensional gas flow, and should give the student the vocabulary and fundamental concepts required to read more complete treatises.

The mixtures chapter gives a general discussion of gas mixtures, which should give the student some familiarity with pound mole calculations, and the enthalpy and entrophy of mixtures. The main part of the chapter is devoted to the air-water system.

The problems appear to be well selected and inducive of mental effort on the student's part.

Practical Hints

ELECTROMETRIC pH DETERMINATIONS THEORY AND PRACTICE. *By Roger G. Bates. John Wiley & Sons, New York. 331 pages. $7.50.*

Reviewed by F. C. Nachod

No single physical property has been of more importance in the technical progress of man as well as to man himself than hydrogen ion concentration. L. J. Henderson has said that "acidity and alkalinity surpass all other conditions, even temperature and concentration of reacting substances, in the influence which they exert upon many chemical processes".

A noted authority in the field of pH measurement from the Bureau of Standards, Dr. Bates has brought together not only the thermodynamic foundation, but also the practical side of the pH field in a clear, concise and readable book. This reviewer is particularly intrigued with the many practical hints (electrode design, platinization, liquid junction errors) which will be of equal importance and value to all.

Recent Books Received

Brand of the Tartan, the 3M Story. By Virginia Huck. Appleton-Century-Crofts. $3.50.

Brazing Manual. Prepared by American Welding Society. Reinhold. $4.75.

Industrial & Manufacturing Chemistry. Part 1. Organic. 7th ed. By G. Martin and E. I. Cooke. Philosophical Library. $17.50.

Industrial & Manufacturing Chemistry. Part 2. Inorganic. Vol. 1. 6th ed. By G. Martin and W. Francis. Philosophical Library. $17.50.

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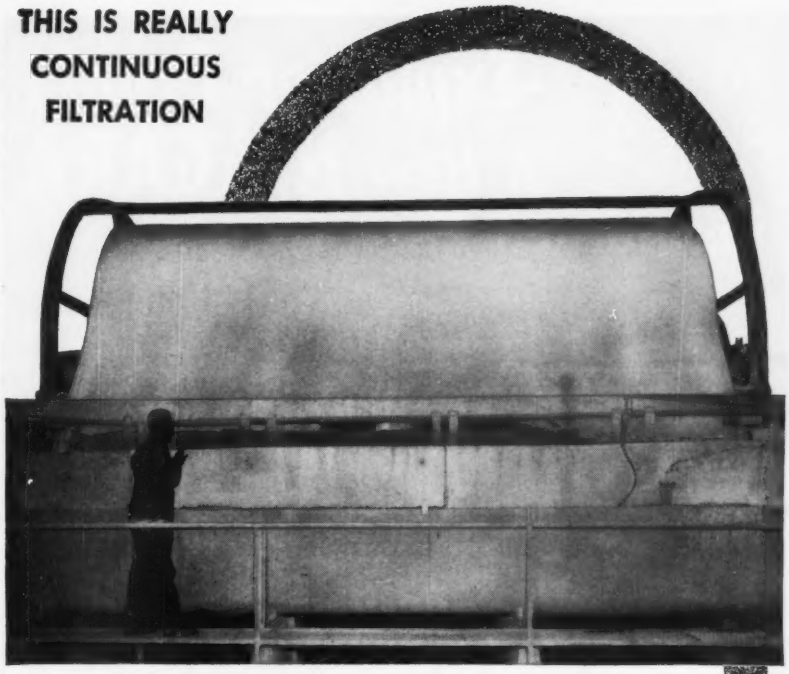

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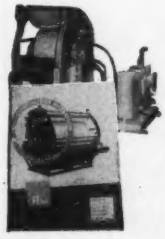

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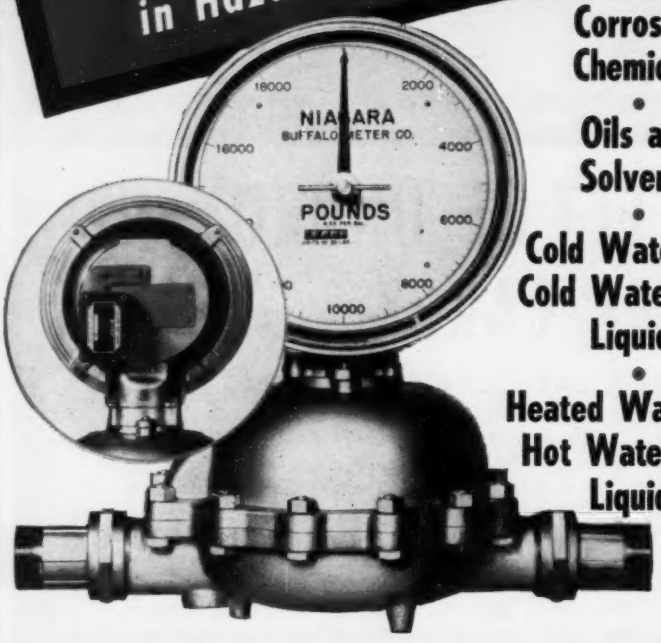

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THIS MONTH'S

Recent Books

Water Pollution

Report on the findings of laboratory and field investigations of the travel of pollution from direct recharge into underground formations. How these findings affect the practicality of replenishing ground water basins by injection of reclaimed waste waters. 218 pages.

"Report on the Investigation of Travel of Pollution." State Water Pollution Control Board, 721 Capitol Ave., Sacramento 14, Calif.

Smog

Digest of all available information bearing on the Los Angeles air pollution problem as of late 1954. Includes sections on the chemical aspects and study of combustion products. 89 pages.

"First Technical Progress Report of the Air Pollution Foundation." Air Pollution Foundation, Los Angeles, Calif.

Lubricants

This report of Air Force research surveys the potential availability of raw materials from which ester-type lubricants can be made and evaluates many types of esters to determine their suitability as lubricants for high-power aircraft engines. 168 pages.

"Synthetic Lubricants." Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. $4.25.

Chemico-Atomic Reciprosity

Survey discusses several of the areas in the field of atomic energy in which chemical companies are active and the reciprocal nature of the relationship.

"Atoms and Chemistry." F. Eberstadt & Co., 39 Broadway, New York, N. Y.

Gulf Chemicals

Listings of Texas Gulf chemical

& Pamphlets

manufacturers and of products manufactured are each catagorized into organic chemicals, inorganic chemicals, and intermediates and products for easy reference. 28 pages.

"Chemicals in the Texas Gulf Coast." Texas National Bank, P.O. Box 2559, Houston, Tex.

Infrared

Comprehensive bibliography on infrared radiation covers: infrared theory; general infrared-optical properties; elements and components of infrared equipment, spectroscopy, photography; applications in technology, arts, industry. Includes all references up to 1951. 374 pages.

"Infrared: A Library of Congress Bibliography," PB 111643. Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. $3.

Thermocouples

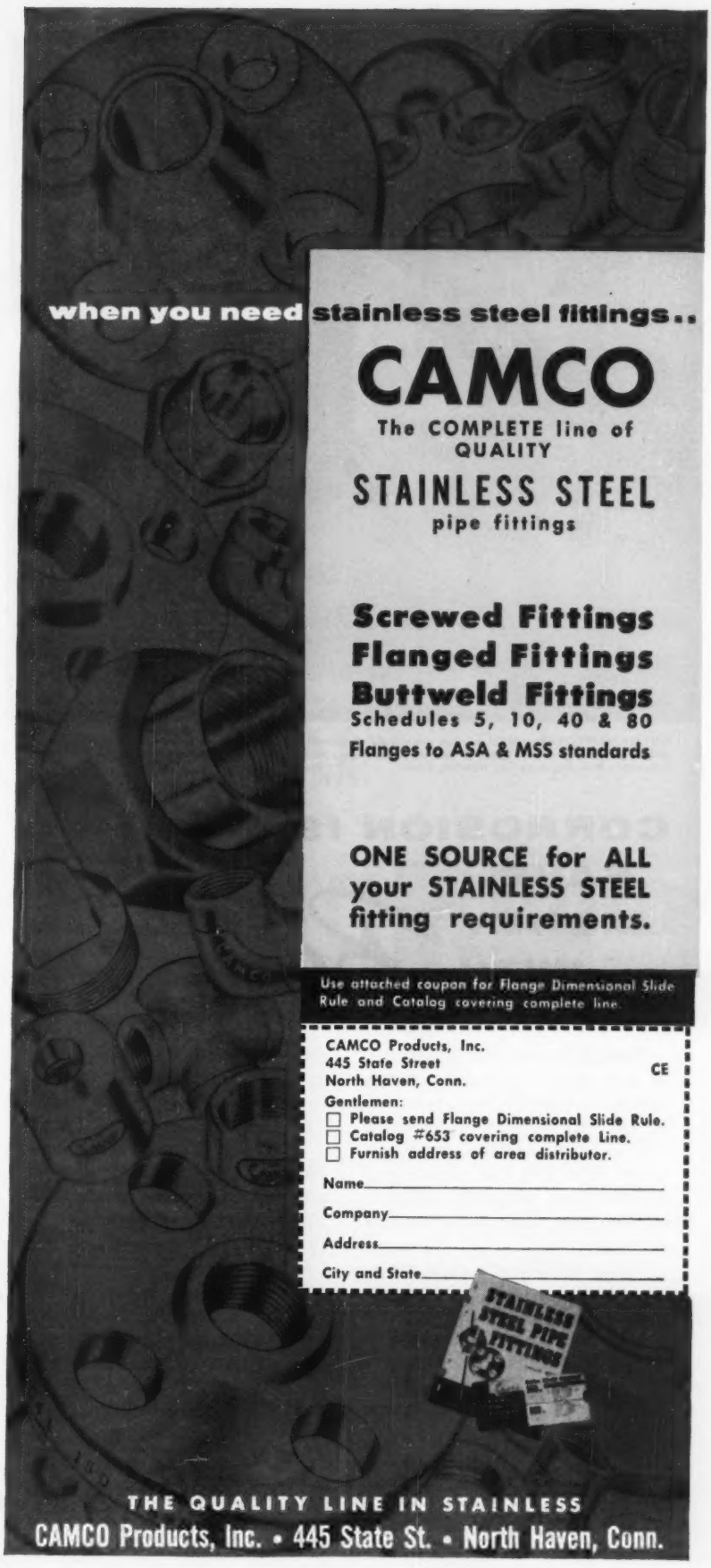
Expanded reference tables for platinum-platinum-10% rhodium, platinum-platinum-13% rhodium, chrome-alumel, iron-constantan (modified 1913), copper-constantan, and chromel-constantan thermocouples, with temperature in centigrade and Fahrenheit and electromotive force in millivolts as the arguments. 84 pages.

"Reference Tables for Thermocouples." National Bureau of Standards, U. S. Dept. of Commerce, Washington 25, D. C. 50¢.

Specialties

Over 50 technical papers and reports on subjects of interest to the following chemical specialty fields: automotive, disinfectant and sanitizers, insecticide, soap-detergents-sanitary chemicals, waxes and floor finishes. 210 pages.

"Proceedings of the 41st Annual Meeting." Chemical Specialties Manufacturers Assn., 50 East 41st St., New York 17, N. Y. $7.50.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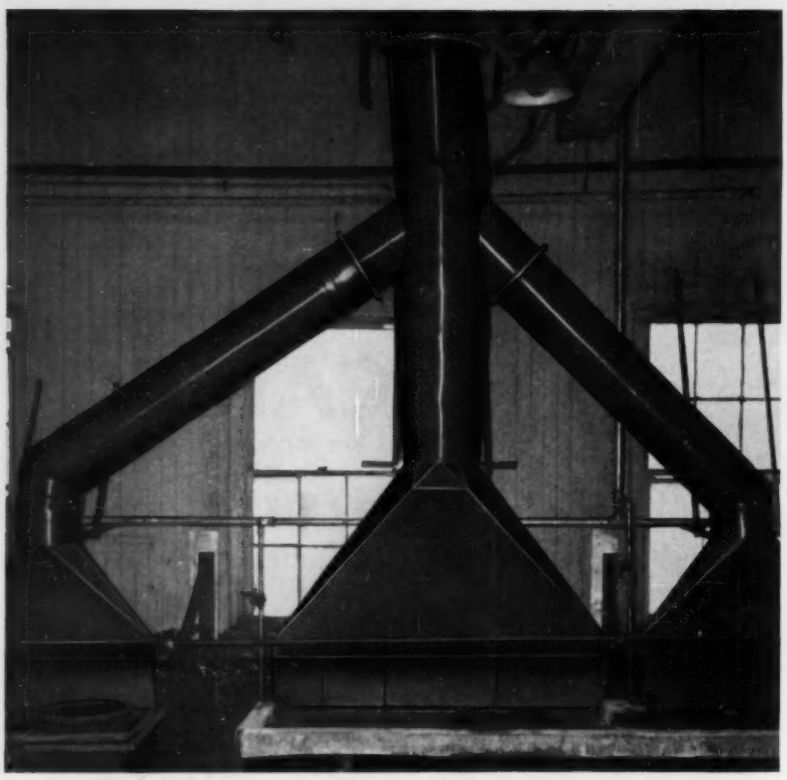

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PAMPHLETS . . .

Aerosols

Industry-recommended manufacturing and sales practices. The compilation includes sections on labeling, premarketing product checks, filler safety tips, and postal regulations on mailing of pressurized packages. 52 pages.

"Manual for Vendors and Fillers of Aerosols and Pressurized Packages." Chemical Specialties Manufacturers Assn., 50 East 41st St., New York 17, N. Y. 50¢.

Noise

Survey of the literature on the noise problem and its solution contains 2,336 references arranged chronologically and indexed by subject and by author. 364 pages.

"An Annotated Bibliography on Noise, Its Measurements, Effects and Control." Industrial Hygiene Foundation, 4400 Fifth Ave., Pittsburgh 13, Pa. $7.50.

Lithium

As a reference work and guide to research on lithium and its compounds, here are abstracts of 173 papers published during 1952 and 1953.

"Supplement No. 3 of the Annotated Bibliography on the Use of Organolithium Compounds in Organic Synthesis." Lithium Corp. of America, 2526 Rand Tower, Minneapolis 2, Minn.

Sewage

Aside from a more permanent binding (cloth instead of paper), up-to-date illustrations and a number of text revisions, this 4th edition discusses much of what appeared in earlier editions—composition of sewage, microbiology of sewage treatment, stabilization of sewage, treatment, plant operation. A handy reference for those engaged, directly or indirectly, in this field. 130 pages.

"Principles of Sewage Treatment." By Willem Rudolfs. National Lime Assn., 925 15th St., N.W., Washington 5, D. C. $1.25.

Industrial Hygiene

Transactions of the annual meeting, 1954, of the Industrial Hygiene Foundation cover medical, legal, chemical-toxicological and engineering aspects of the subject, discussed by experts. 241 pages.

"Transaction of the 19th Annual Meeting and Technical Conferences of Industrial Hygiene Foundation." Industrial Hygiene Foundation of America, Mellon Institute, 4400 Fifth Ave., Pittsburgh 13, Pa $5.

Soda Ash

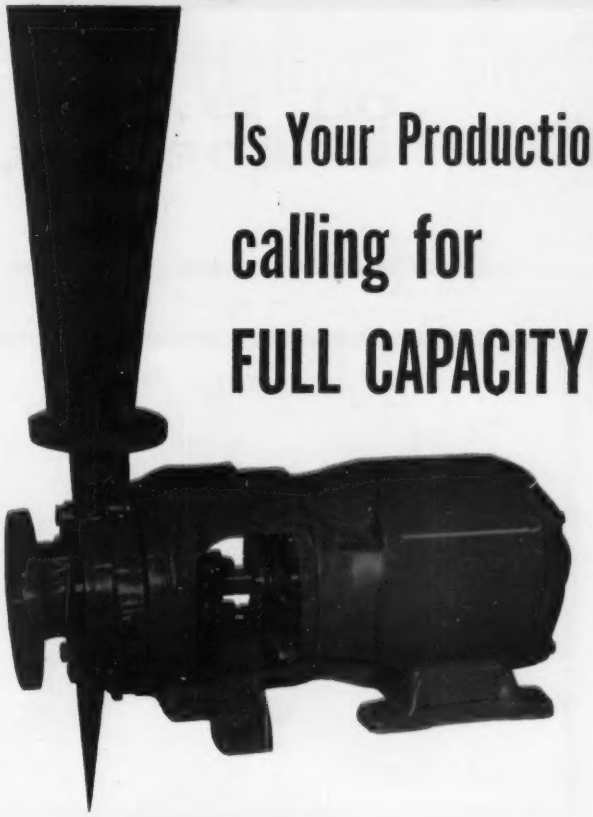
All kinds of information on soda ash including analytical and sampling methods, reactions, production data, tips on handling and storage, safety precautions. 96 pages.

"Wyandotte Soda Ash." Wyandotte Chemicals Corp., Wyandotte, Mich.

Chemical Statistics

Drawing on information published by various government agencies, this 4th edition covers significant chemical statistics for the years 1950 through 1953. Included in over-all industrial statistics you'll find figures relating to personnel and production. Personnel: number of wage earners, wages, hours, number of strikes. Production: imports and exports; production and sales of inorganic chemicals, sulfuric acid, chemical nitrogen, tars, synthetic organics (including petroleum chemicals), coal-tar dyes, plastics, fats and oils, metals and minerals. Financial records of 100 chemical process companies are also tabulated. For more up-to-date statistics, current summaries of this handbook will soon be issued on a semi-annual basis. Book has broad appeal for management, research and production personnel. 412 pages.

"Chemical Statistics Handbook." Manufacturing Chemists' Assn., Inc., 1625 Eye St., N. W., Washington 6, D. C. $2.50 for members, $3 for nonmembers.



Is Your Production calling for FULL CAPACITY?

put the powerful Ingersoll-Rand MOTORPUMP on the job!

You can get delivery from 5 to 2800 gallons per minute from Ingersoll-Rand Motorpumps—yet the largest unit requires only about 5' x 2' in floor space! They're designed and built to give you maximum performance with space-saving compactness you'll welcome.

They're exceptionally versatile, too. They operate in any position without need for a baseplate or special mounting. Nor is a coupling required, because the motor's heavy-duty shaft is connected directly to the pumping unit.

If you want smooth operation from pumps that promise lowest maintenance costs in the field, get more detailed information by writing for our latest Motorpump bulletin showing size 1/4-75 hp.

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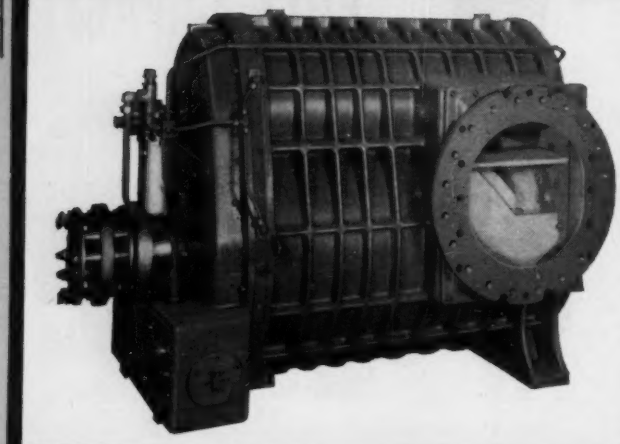
OIL IS... WONDERFUL



but not when it contaminates compressed air or gas

The Standardaire Blower assures you of absolutely oil-free compressed air or gas. It delivers totally clean air or gas, thanks to a superior oil sealing arrangement.

This is just one of the many advantages offered by the Standardaire Blower. This rugged, compact unit provides greater capacity per pound of blower, with less power consumption.

How? Through its exclusive cycloidal, screw type rotors which compress air in a modified adiabatic cycle. The air is taken in and discharged smoothly from pockets which form between the rotors.

There's a Standardaire Blower for your requirements . . . either low, medium or high capacity. Write today for further facts and information.

READ STANDARD
CORPORATION

BLOWER-STOKER DIVISION
370 Lexington Avenue, New York 17, New York

THIS MONTH'S

Firms in

New Names

The name of the **Johns-Manville** Van Cleef division has been changed to **Dutch Brand** division to further identify "Dutch Brand" products with Johns-Manville's national promotional programs.

Barnes Engineering Co. has been designated as the new name of Olympic Development Co. of Stamford, Conn.

New Lines

Foxboro Co. is now offering the Liston-Becker infrared gas analyzer for continuous quantitative analysis of process stream components.

New Locations

North California sales offices of **Wolverine Tube,** Division of Calumet & Hecla, Inc., have been moved from San Mateo to San Francisco.

Spencer Chemical Co. has transferred its central engineering and central purchasing departments from Pittsburg, Kan., to Kansas City, Mo.

Pennsylvania Salt Mfg. Co. has moved its executive offices from 1000 Widener Bldg. to Three Penn Center Plaza in Philadelphia.

F. J. Stokes Machine Co., Philadelphia, has opened a new sales office in Toronto.

Texas Instruments Inc. has opened a Los Angeles sales office, the first of several offices scheduled to be opened this year.

Jefferson Chemical Co. has transferred its headquarters offices from New York to Houston, Tex.

The chemical department of **McKesson & Robbins, Inc.,** has es-

the News

M. A. Gibbons

tablished a district office in Atlanta, Ga.

Hird Chemical Refining Corp., Palo Alto, Calif., will move to a new location in Palo Alto, where it will expand its capacity threefold.

New Representatives

Hammel-Dahl Co., Providence, R. I., has appointed MacGuire Instrument Co., Cayce, S. C. as its sales and service representative.

McKenna Laboratories has appointed Harshaw Scientific, Cleveland, and Atlantex Corp., Boston, to distribute its line of ultrasonic equipment in the laboratory field.

General Tire & Rubber Co. has appointed the following as chemical sales agents in the paint manufacturing industry: Cary Co., Chicago, Harry A. Baumstark and Co., St. Louis, Thompson-Hayward Chemical Co., Kansas City, Mo.

International sales office of **New York Air Brake Co.** has announced the appointment of Williams & Wilson Ltd. as distributors for eastern Canada of Kinney Manufacturing Division products.

Yale & Towne Mfg. Co. has announced the establishment of two representatives to handle its line of industrial lift trucks: Kimball Industrial Sales Corp., South Bend, Ind., and H. W. Carpenter Co., Peoria, Ill.

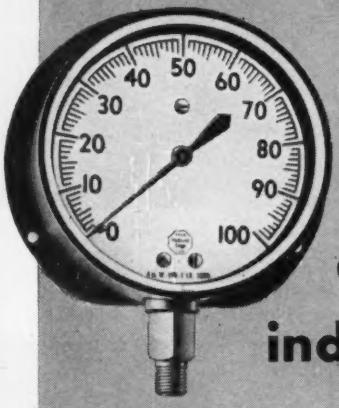
A. Gross & Co. has announced the appointment of Carl A. Lechner Co., Chicago, as distributor of its complete line of fatty acids and glycerides.

American Viscose Corp. has given Societe AMELIORAIR, Paris, exclusive permission in Europe

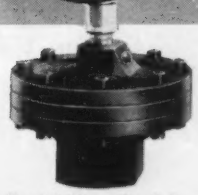
an ACCO product

Helicoid Gages

Why HELICOID is the Quality Gage for every pressure indicating service



Acaloy Case Helicoid Gage
Suitable for tap water, steam, inert gases, oils, coal gas and many chemicals.



Helicoid Chemical Gage
Suitable for chemicals and other viscous liquids which might corrode or clog Bourdon tube.

Built RIGHT

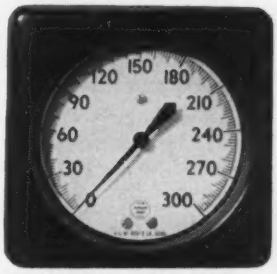
Exclusive HELICOID gearless movement. Bourdon tubes of maximum endurance life. Gives highest degree of *sustained accuracy*.

Stay RIGHT

No gear teeth to wear out. Convenient external pointer adjustment. Protected from sudden overpressure or pressure reduction.

Sold RIGHT

Experienced HELICOID gage engineers are available to help you choose the gage you need. Distributors are conveniently located. Write for the name of the one nearest you.



Acaloy Square Flush Case
This is a weather-proof case and ideal for use in symmetrical panels.

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Helicoid Gage Division
AMERICAN CHAIN & CABLE

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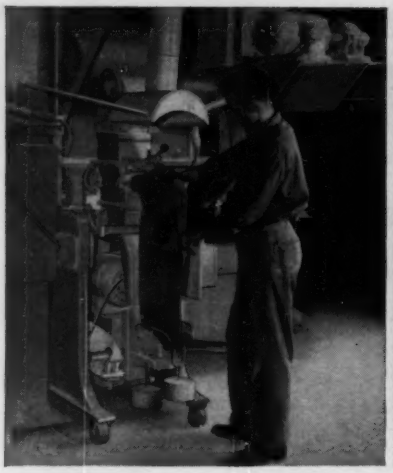
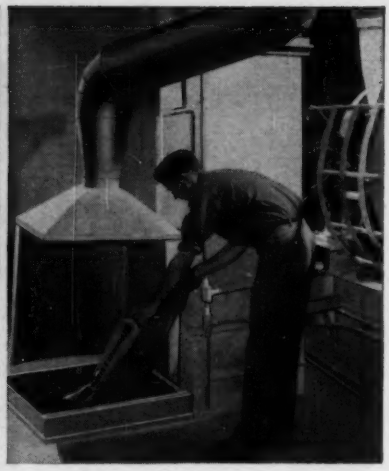
for Better Value



Note the cleanliness as bag is loaded. The dust-laden air is drawn into the hood, thence through the duct to the filter. Cleaned air is returned to the plant.



Note, also, equal cleanliness in dumping. Hoods and ducts are expertly engineered to handle all the dust.

when you load or unload bags

USE SLY DUST FILTERS

This is the Sly Dust Filter located outside the plant of the Haviland Products Company, Grand Rapids, Michigan. It handles 7,000 cfm.

and you will be free from the *annoyance* and *hazard* and *expense* of dust.

Such is the experience — a typical one — of the Haviland Products Co. Note how clean and dust-free bag loading and unloading now are.

Aggravated about dust — the trouble and expense it caused — management over a year ago installed Sly Dust Filters. Results: the company executives are highly pleased with the better working conditions, clean plant and substantial savings realized.

Since 1874, Sly has pioneered and developed positive dust collection equipment . . . the original patentee of the cloth type filter more than 50 years ago.

No matter what you make or process — if there's dust, you need Sly.

Designers and Manufacturers of Dust Control Systems—Blast Cleaning Equipment — Tumbling Mills — Industrial Ovens.

THE W. W. SLY MANUFACTURING CO.

SINCE 1874

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New York • Chicago • Philadelphia • Rochester • Detroit
Buffalo • Cincinnati • St. Louis • Minneapolis • Houston
Atlanta • Birmingham • Denver • Los Angeles • Toronto

FIRMS . . .

to manufacture the Sylvania Web Conditioner, a moisture control device used in printing of cellophane, glassine and paper.

H. M. Chemical Co., Ltd., and its subsidiary, **Western Amino Acids Co.,** have appointed Lachat Biochemical Co., Chicago and Chemicals Procurement Co., New York, as distributors of their lines of fine chemicals.

Texas Instruments Inc., has appointed Computing Devices of Canada Ltd. as its exclusive Canadian agent.

Vanton Pump & Equipment Corp. has appointed Freeport Engineering Co. as sales agent in South and Central America, as well as Puerto Rico.

Barrett Division, Allied Chemicals & Dye Corp., has appointed International Sales Corp., Seattle, and Roy A. Ribelin Distributing Co., Dallas, as sales agents for Plaskon polyester resins.

Control Equipment Co., Atlanta, Ga., has been appointed exclusive sales representative by **Cuno Engineering Corp.** to handle its line of industrial products which include, Auto-Klean, Micro-Klean and Flo-Klean fluid and gas filters.

New Companies

Cameron and Jones, Englewood, Colo., is a new engineering and consulting firm specializing in oil shale technology. Officers and associates formerly were senior staff members of the U. S. Bureau of Mines oil-shale experiment station, Rifle, Colo.

Manostat Corp., New York, N. Y., will manufacture manostats for industrial use.

Italian financial interests will make a loan to Peruvian and Italian interests in Lima for the construction of a petrochemical plant for production of ammo-

nium products to be used as fertilizer. The operating company will be called **Fertiza Limitada.**

Panellit of Canada, Ltd., is a Canadian affiliate of Panellit, Inc., Skokie, Ill. The new organization will specialize in engineering, design and fabrication of industrial automatic control systems, graphic and control instrument panels and information systems.

National Lead Co. has announced formation of **Abbey Chemicals, Ltd.,** London, England. The new firm will manufacture industrial chemicals including stabilizers and plasticizers for vinyl plastics.

Michigan Steel Casting Co. and Standard Alloy Co. of Cleveland have merged to form **Michigan-Standard Alloy Casting Co.**

George P. Dickey, Inc., Denver, Colo., has been organized to facilitate manufacturing and delivery of all types of gaskets and steel rule dies to users in the Rocky Mountain area.

Lea Manufacturing Co. of England Ltd., Buxton, England, has been formed as an affiliate of Lea Manufacturing Co., Waterbury, Conn.

The following chemical firms have filed charters of incorporation in Delaware: **Pan American Chemicals Corp., Columbia River Chemicals, Inc., Chemicals Cargo Corp.**

Solar Energy Corp. of America, New York, N. Y., has been formed to explore the commercial possibilities of solar energy.

New Facilities

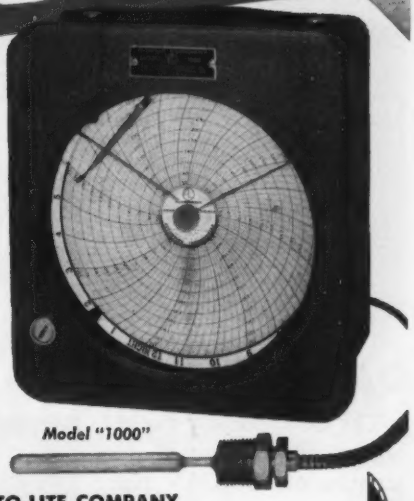
Nopco Chemical Co. plans to complete two new plants—one, in Irvington, N. J.; the other, in Los Angeles—for production of vinyl and urethane foams by the end of the year. Site for a

AUTO-LITE

TEMPERATURE RECORDING...

Newly designed, Model "1000" Auto-Lite Recorder gives permanent proof of temperature behavior. • 6" clear reading chart; various standard ranges from minus 40°F. to plus 550°F. • 3 standard types; choice of 24-hr. or 7-day cycle. • Electric or mechanical chart drive. • With capillary tubing for remote reading. Priced from $49.50.

Send for new catalog describing many styles of Auto-Lite temperature Recorders and Indicators.



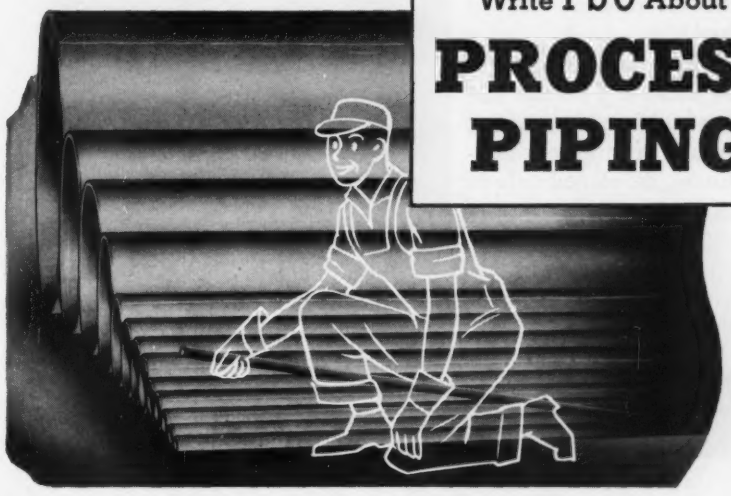
Model "1000"

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

TEMPERATURE RECORDERS

Write PSC About

PROCESS PIPING



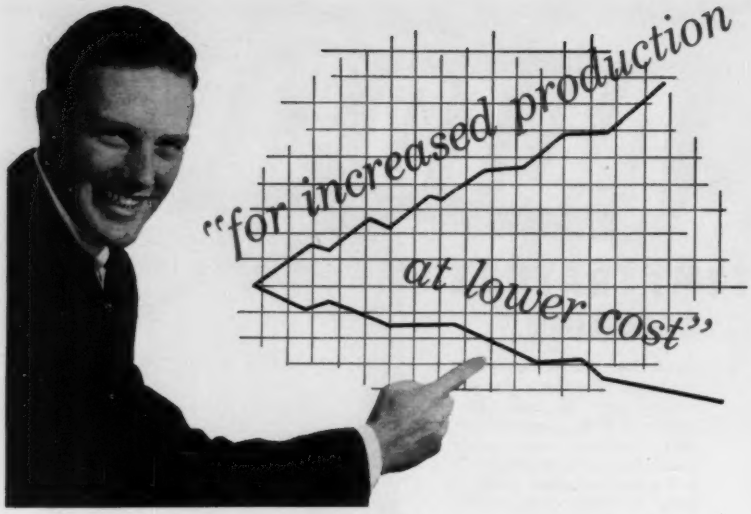
Fabricated from Complete Range of Alloys, Any Diameter Up to 60", and in Any Shape

PSC welded process tubing is furnished in any alloy whatsoever. This feature accounts for its wide application in meeting the unlimited variety of heat, corrosion, oxidation conditions in process plants.

Any diameter up to 60"; wall thicknesses to 3/8"; temperatures to 2200°. Precision fabrication of tubing assemblies is a specialty. Send b/p or write as to your needs.

THE PRESSED STEEL CO., 707 N. Penna. Ave., Wilkes-Barre, Pa.

Custom Fabricators for the Process Industries Since 1928. Send Your Blue Prints

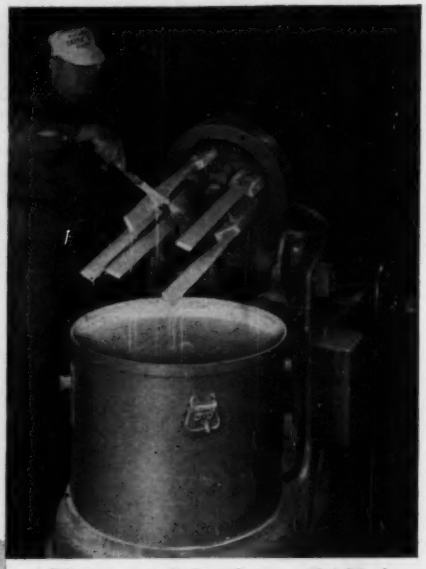


DAY PONY MIXERS *are your logical choice*

The exceptionally rugged, heavy duty design characteristics of the DAY pony mixer enables you to mix a stiffer, heavier paste, resulting in several advantages.

Over-all milling time is reduced by milling a heavier, higher solid-content paste (less volume to mill for same number of cans of finished product).

Milling time is further reduced because a partial dispersion is obtained by taking advantage of internal shearing forces, developed only in a stiff paste.



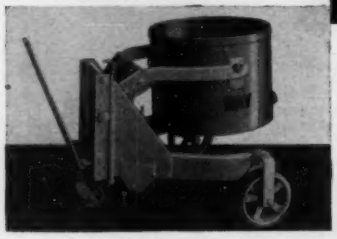


Photo at left shows DAY hydraulic lift truck for extra speed and convenience in handling cans. Available as optional equipment. For complete information on all DAY pony mixers write for free Bulletin 500.

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in mixing equipment **DAY** *means longer life span*

THE J. H. DAY COMPANY
INCORPORATED
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Quality equipment for baking, paint and varnish, printing ink, chemical, rubber, pharmaceutical, cosmetics, paper and pulp, explosives, food, ceramics, candy, soap, sugar and milk products.

Eastern Canada: Brantford Oven & Rack Co., Ltd., Brantford, Ontario
Western Canada: British Canadian Importers, Vancouver, British Columbia
Mexico: T. de la Pena e Hijos, S.A., Nazas 45-A, Mexico 5—D.F.

FIRMS . . .

third plant, to be completed next year, has not been announced. Nopco has also acquired the assets of the Griffin Chemical Co., San Francisco.

Brown Co., pulp, paper and chemical manufacturers, has started immediate expansion of the marketing of New England forest products throughout Western Europe.

Pennsylvania Salt Mfg. Co.'s financial division has absorbed the central purchasing and traffic functions.

Controlling interest of **Fox De Luxe Brewing Co.** and **Kio Oil and Development Co.** has been acquired by Arthur J. Feicht & Co., insurance brokers, and associated, but unidentified interests.

Sharples Chemicals Inc. has been dissolved as a corporation and become an operating division of Pennsylvania Salt Mfg. Co.

Olin Mathieson Chemical Corp. has more than doubled its timber resources by acquiring Brown Paper Mill Co., Inc., West Monroe, La.

Pakistan's Industrial Development Corp. and two German firms—**Farbenfabriken Bayer** and **Farbwerke Hoechst**—have signed an agreement to set up a $1.2 million dye-stuff factory in Karachi.

Board of directors of **Key Co.**, East St. Louis, Ill., has approved an offer by ACF Industries, Inc., to purchase Key's assets. Key makes oil refinery, chemical plant and power plant equipment.

Tube Reducing Corp., Wallington, N. J., has announced plans to expand facilities for the manufacture of a special type cold finished tubing to be named "Rockdrawn" tubing.

Stockholders of **Monsanto Chemical Co.** have voted to increase the authorized common stock of

the company from 6,000,000 shares of $5 par value each to 25,000,000 shares of $2 par value each and authorized a three-for-one split of the company's outstanding stock.

Dow Chemical Co. has elevated its Minneapolis and Cincinnati field offices to full sales office rank. The company has also announced plans to open a new sales office in Buffalo.

Borden Co.'s chemical division has completed a new building and installation of new equipment at the monomer department's Leominster, Mass., plant, thus tripling output of all grades of "Lemol" polyvinyl alcohols.

Standard Oil Co. of Calif. has completed two of the largest refining units in its $50 million program to upgrade gasoline quality. The twin facilities are catalytic reformers which have been placed onstream at Standard's Richmond and El Segundo refineries.

British Columbia Cement Co. is undertaking a two-year, $4 million extension to its Bamberton plant on Vancouver Island which will make it the largest in the Pacific Northwest with an annual 3.2 million bbl. capacity.

Stockholders of **General Instrument Corp.** have approved the company's acquisition of Automatic Mfg. Corp., Newark, N. J.

Toms River-Cincinnati Chemical Corp. has purchased the net assets and business of Ciba States Ltd.-Toms River division.

Stanford Research Institute will provide the Bank of America with research and counseling services in the field of atomic energy.

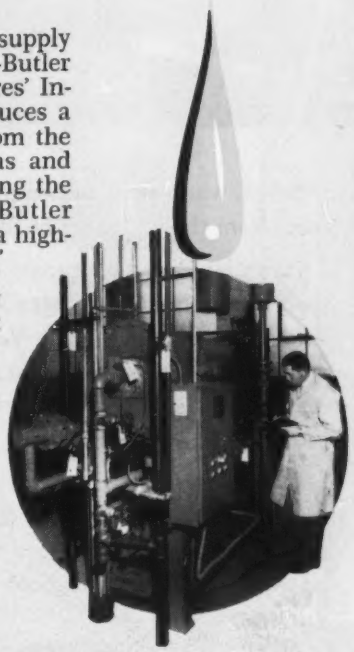
Catalytic Construction Co. has completed construction of two Houdriflow catalytic cracking units for Sun Oil Co. at its Marcus Hook, Pa., and Toledo, O., refineries.

GAS ATMOSPHERES' GENERATOR SOLVES STICKY VARNISH PROBLEM FOR McDOUGALL-BUTLER . . .

Varnish quality is dependent on the amount and purity of the inert gas that blankets the cooking of alkyds. McDougall-Butler Paint Co., Buffalo, N. Y., had been using a CO_2 obtained from dry ice.

To get a dependable gas supply at lowest cost, McDougall-Butler selected a Gas Atmospheres' Inert Generator which produces a Nitrogen CO_2 mixture from the combustion of natural gas and air. After thoroughly testing the equipment, McDougall-Butler engineers pronounced it "a highly satisfactory generator."

If your operation calls for gaseous atmospheres, let Gas Atmospheres' engineers hear about it. We'll be happy to estimate costs. Just let us know the type and quality gas needed and we'll show you why you can't afford to be without a Gas Atmospheres' generator.



gas Atmospheres, inc

equipment for producing industrial gases

20011 WEST LAKE ROAD CLEVELAND 16, OHIO

Sweet, wholesome canned pineapple juice and pineapple slices come from the center of the fruit. But what happens to the skin?

Hawaiian Pineapple turned the peels into dollars by extracting the juice from these otherwise wasted materials. The juice is then clarified by two Oliver Vacuum Precoat Filters. The filtrate is further processed to obtain pure natural fruit sugar, and pure crystallized citric acid, which become end products that add to the profit.

If you have a problem involving the separation of finely divided solids in suspension, the use of fluidizing techniques or ion-exchange, the chances are that Dorr-Oliver and its Associated Companies throughout the world can be of service to you.

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INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U.S.A.

FIRMS . . .

Byron Jackson Co. has announced reorganization and expansion of its mechanical seal product division.

Continental Can Co. has started construction of a new one-story plant in Midland, Mich., for the manufacture of fibre shipping drums.

National Starch has started operation of its second polyvinyl resin plant in Meredosia, Ill.

Girdler Co. has been awarded a contract by National Aniline Division of Allied Chemical and Dye Corp. to design and erect a combination hydrogen and carbon monoxide manufacturing plant at the company's Moundsville, W. Va., works.

Continental Sulphur & Phosphate Corp. has started production at its sulfur refining plant at Sulphurdale, Utah.

Barrett Division, Allied Chemical and Dye Corp., has organized a thermoplastic sales group to serve the thermoplastics industry.

California Spray-Chemical Corp., Richmond, Calif., has constructed a new bio-screening laboratory in Richmond. The new lab will be used to develop new, safer and more effective Ortho pesticides.

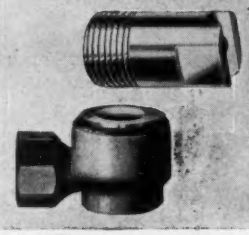
Longview Fibre Co., Longview, Wash., has placed an order for its seventh paper machine in an expansion program intended to boost daily output while the company's Springfield, Ore., operation is being developed.

Hercules Powder Co. has started construction of a $6 million pentaerythritol plant at Louisiana, Mo. The unit is slated for completion late next year.

Celanese Corp. is constructing the first unit of a new chemical plant at Gallipolis Ferry near Point Pleasant, W. Va. The plant will produce plasticizers, hydraulic

here's why we chose Spraying Systems

SPRAY NOZZLES



LOWER COST—it's surprising how often changeover to Spraying Systems nozzles reduces cost and materially improves the end product or process . . . due to unique design concepts and precision.

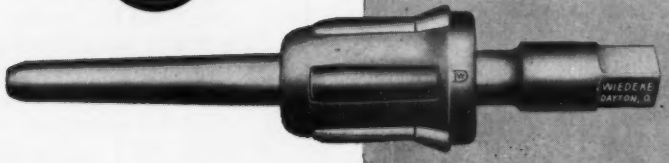
SELECTION—the range of choice in *standard* nozzles is amazing . . . over 10,000 in Catalog 24 alone . . . a type and capacity to fit exactly almost every need. It's rare that costly "specials" are needed.

PROMPT DELIVERY—huge stocks are maintained for fast delivery. For emergency needs, overnight delivery by air is a dependable part of Spraying Systems service.

Write for your free copy of Catalog 24 .

SPRAYING SYSTEMS CO.
3275 RANDOLPH STREET BELLWOOD, ILLINOIS
America's leading producers of Spray Nozzles

IDEAL



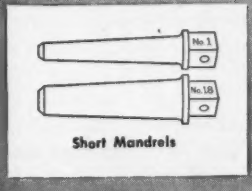
For modern Water Tube Boilers

Series 1500 Tube Expanders

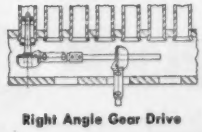
. . . Recommended for use with Drum or with short Header Mandrels.

Right Angle Drive speeds-up rolling operation of any Tube inside round or square Header.

See your Dealer or write us for Bulletin.



Short Mandrels

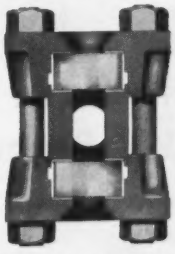

Right Angle Gear Drive

THE GUSTAV **WIEDEKE** COMPANY
DAYTON 1, OHIO

Strahman

HIGH PRESSURE GAUGES

USED IN
REFINERIES
AND
CHEMICAL PLANTS
THROUGHOUT THE WORLD



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Single or Multiple Sections

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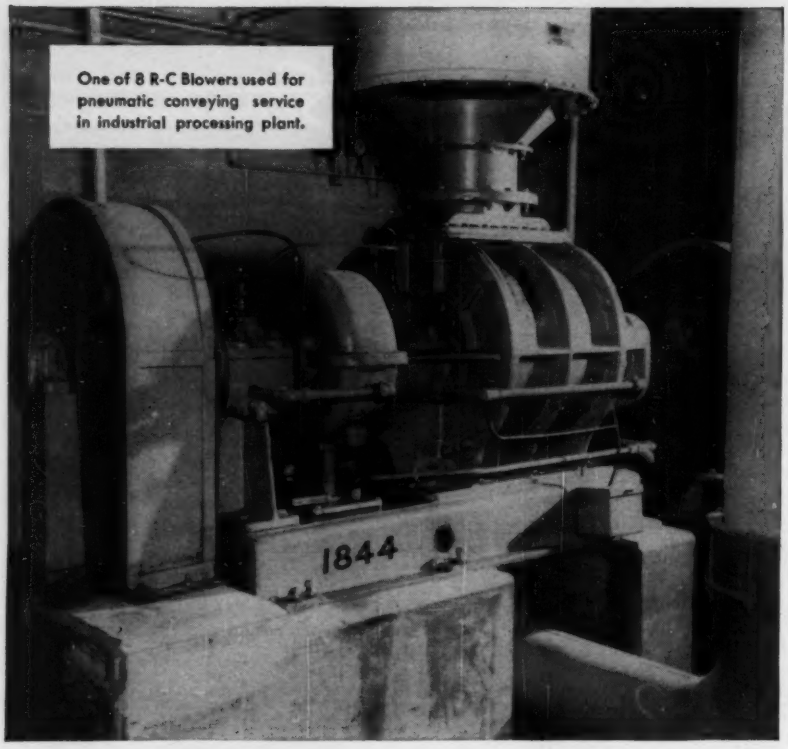


One of 8 R-C Blowers used for pneumatic conveying service in industrial processing plant.

No failures in volume or pressure with R-C Rotary Positive Blowers

CHECK THE "BIG 4" ESSENTIALS

1. Accurate volume at required pressure
2. High efficiency—low operating cost
3. Low maintenance cost —low down time
4. Freedom from oil or oil vapor contamination

Check your present blowers and if they don't measure up, it may be an economy to replace them with modern R-C equipment.

In any needed capacity, from 5 cfm to 50,000 cfm, R-C Rotary Positive Blowers faithfully and accurately deliver their rated volumes and pressures. That's one most important reason for their wide use in industrial plants.

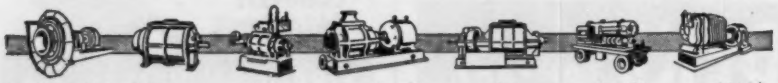
But there are other reasons, too, for the selection of R-C Blowers. The list of "BIG 4" essentials shows why sturdy R-C Rotary Positive Blowers have long been "standard" with thousands of purchasers.

If you have a job of moving air or gas, call the R-C engineer. With a choice of Rotary Positive, Centrifugal and the new Spiraxial units, he can give you unbiased counsel and suggestions. Or, ask for bulletins on equipment for new installations or replacements.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
955 Illinois Ave. • Connersville, Indiana

Roots-Connersville Blower (Canada) Ltd. • 629 Adelaide St. W., Toronto, Ont.



Centrifugal and Rotary Positive Blowers and Exhausters • Positive Displacement Meters • Vacuum Pumps • Gas Pumps • Inert Gas Generators • Spiraxial Compressors

FIRMS . . .

fluids and other compounds for the automotive and aircraft industries.

Harshaw Chemical Co., through its subsidiary, Zinsser & Co., has purchased the pigment color division of United Wallpaper, Inc., Aurora, Ill.

Beckman Instruments, Inc., has purchased the Liston-Becker Instrument Co., Springdale, Conn.

Acheson Dispersed Pigments (Texas) Co. plant at Orange, Tex., is doubling production capacity due to increased demand by the plastics industry in that area for adp pigment dispersions.

National Research Corp. has formed a nuclear energy department.

Construction has begun on the new **Socony Mobil Oil Co.** pipelines terminal at Tremley Point, near Linden, N. J. The new terminal will replace facilities which the company leases in Perth Amboy.

Cosden Petroleum Corp. is planning 3,700 bbl.-per-day catalytic reforming unit for its Big Spring, Tex., refinery. New unit's output will be used for upgrading stocks for motor fuel, while existing 4,275 bbl.-per-day Platformer-Uxex unit will be shifted to 100% aromatics production.

Fluor Corp., Ltd., has been awarded a contract by the Utah Oil Refinery Co. to engineer and construct a 5,500 bbl.-per-day ultraforming unit at Salt Lake City.

British Celanese Ltd., London, is constructing a plant for production of vinyl acetate monomer at its Spondon, Derbyshire, works.

Vibro-Ceramics Corp., an affiliate of Gulton Industries, Inc., Metuchen, N. J., has inaugurated a comprehensive consulting service in all phases of ultrasonics for industrial and scientific programs.

COLTON

FINEST QUALITY

STAINLESS STEEL TANKS

ALL TYPES—STORAGE—PROCESS

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AGITATORS

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have proved their efficiency and versatility in countless applications. For example:

1 OUNCE KILLS FOAM IN...

625,000 lb
sodium bromide crystallization solution

250,000 lb
molasses, vat dye solution, trioxide pickling solution, tall oil

125,000 lb
phenolformaldehyde, urea formaldehyde, asphalt, starch sizing

62,500 lb
soft drinks, 70% caustic liquor, black liquor, sulfuric acid pickling bath

And remember—both Dow Corning Antifoam AF Emulsion and Antifoam A are physiologically harmless. Both increase production, reduce processing time, eliminate the waste and fire hazard of boil-overs.

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Here's your opportunity to explore *all* the advantages of a modern package handling system... *before* you buy. Our team of experienced ALVEY conveyor engineers will work with your own technical staff to develop a plan that is precisely right for your requirements. They'll show you how it will speed production and save man-hours in your plant.

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Every time you MANhandle a product, you add to its cost... *without* adding to its value.

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Branch Offices in Principal Cities

196

FIRMS . . .

Horace Blackman Co. and its affiliate, **Blackman Plastics, Inc.**, Culver City, Calif., have created a new experimental-development section and revamped their entire facilities.

Gulf Oil Corp. has let contracts for the construction of two units for the super-refining of home heating oil at its Port Arthur, Texas, refinery to M. W. Kellogg Co.

Port Commission of Tacoma, Wash., has accepted a $20,960 bid from the **General Chemical Division,** Allied Chemical and Dye Corp., of two lots in Tacoma's tideflats industrial district. The plant will manufacture liquid aluminum sulfate.

A Southern California Industrial Research Center has been established at the University of Southern California as an administrative division of the school of engineering.

Installation of new equipment at **Diamond Alkali Co.'s** Painesville, Ohio, plant will make possible a 320,000-bbl. increase in annual productive capacity of standard portland cement.

Construction work has started on **Pittsburgh Plate Glass Co.'s** plate glass plant at Cumberland, Md.

Reichhold Chemicals, Inc., has completed arrangements for a $10 million combination bank loan and debenture, the money to be used for long range expansion and additional working capital.

International Cellucotton Products Co. and **Kimbely-Clark Corp.** directors approved a plan calling for complete integration of the two companies.

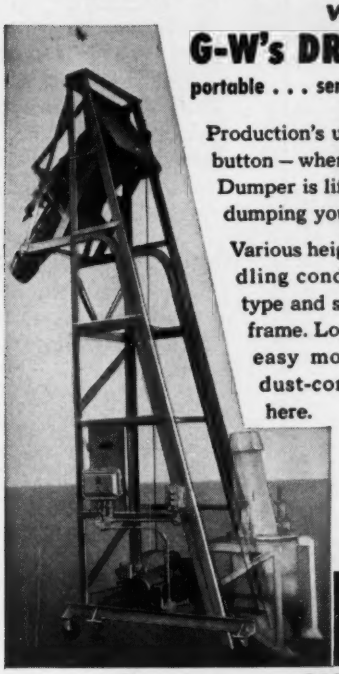
Dominion Foundries & Steel, Ltd., is planning a program of expansion which will increase production in existing plants and take it into the manufacture of

All you lift is your finger!

Production UP—costs down with

G-W's DRUM DUMPER

portable . . . semi-automatic . . . strong



Production's up—with the press of a button—when a rugged G-W Drum Dumper is lifting and automatically dumping your drums.

Various heights to suit specific handling conditions. Units for any type and size drums. Heavy steel frame. Long-life truck casters for easy moving. Available with dust-control spout, as shown here.

FREE! Write for G-W's idea book on engineered materials handling systems.

GIFFORD-WOOD CO.

HUDSON, N. Y. AND PRINCIPAL CITIES

CONTROL OF COMPLEX CHEMICAL CONTAMINANTS made simple with MULTI-WASH COLLECTORS

Dust Dust particles are removed from the air stream by impingement against wetted surfaces and through water curtain action. The constant change in direction of the air stream and its effect in creating turbulent action in the liquid serves to keep the inside collector surfaces clean. Effectiveness on both soluble and insoluble dusts is about the same.

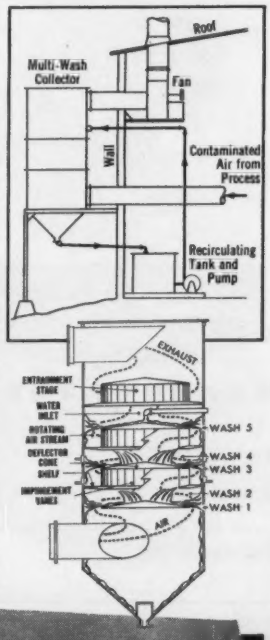
Fumes Fumes are also removed by impingement against the closely spaced turbine-like stationary vanes and flushed surfaces of the shell, deflectors and shelf plates. High collecting efficiency is obtainable even on sub-micron material.

Condensable Vapors Through contact with the cooler liquid and wetted surfaces, many materials which are gaseous at high inlet temperatures are condensed into liquid droplets. These droplets are then collected by impingement, as in the case of dusts, and thus removed from the air stream.

Soluble Gases The intensive action of the air stream with the water curtains and spray patterns makes the Multi-Wash Collector very effective in the removal of soluble gases.

Acid Gases and Odors Many successful installations are in operation where the gaseous contaminant in the air stream is removed through chemical reaction with the recirculated liquid. For example, hydrogen sulphide, sulphur dioxide, hydrochloric or hydrofluoric acid vapors will react readily with an alkaline solution. Some more complex odors can be removed or stabilized by means of an oxidizing chemical in the recirculated liquid.

Corrosion-resistant Construction Standard Multi-Wash Collectors are constructed of heavy plain carbon steel. Special units are constructed of various types of stainless steel, Monel, Inconel, Hastelloy, Haveg, copper or steel with special coatings to protect interior surfaces against corrosive action and assure long, efficient operation.



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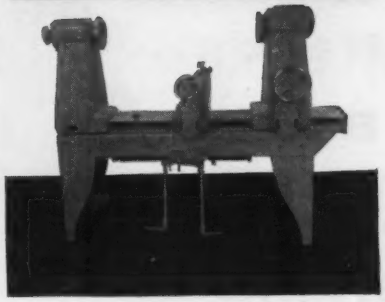


MODEL ME

$3135.00 f.o.b. Grass Valley, Calif.
Especially useful for handling large television Bulbs

GENERAL SPECIFICATIONS

Maximum length overall	84"
Maximum width overall	27"
Maximum length, spindle nose to spindle nose	47"
Height, floor to spindle	52⅝"
Radial clearance above apron	21¼"
Spindle hole diameter	3⅞"
Approximate shipping weight	1800 lbs.
Net weight	1600 lbs.

STANDARD EQUIPMENT

Two face plates
One collet draw-in bar
Hand carburetion control
Foot pedal control of air or nitrogen supply and oxygen-gas volume
Main air valve controlling air in either or both spindles
Standard spindle speeds approx. 30-40-60 RPM. (With Adjusto Spede 17½-175 RPM.)
½ h.p. motor, 220 volt, 3-phase

DO YOU KNOW?

That a first class glassblowing job requires accurate alignment of rotational axes between the headstock and footstock?

That variable spindle speed gives another dimension to your technique?

That simple chucking attachments supply versatility for wide varieties of applications?

That special chucking for your industrial procedures, or laboratory practices are available?

That Litton jet-mix fires are universally used in glassblowing to prevent reducing conditions?

That Litton Lathes have been the standard of the vacuum tube industry for 22 years, and have been constantly improved?

That you can get these precision tools at reasonable cost, in eight sizes, with swing from 8" to 42", and working length from 20" to 75½"?

Let us send you complete specifications and prices on our line of equipment and tools for the Vacuum Tube industry and for general research and development laboratory use.

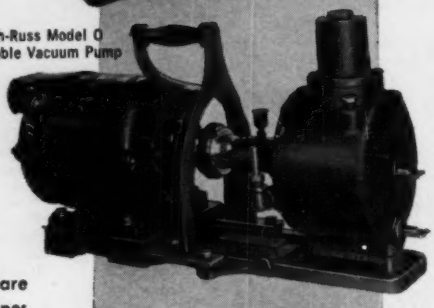
3238

Litton Engineering Laboratories
Grass Valley, California - P. O. Box 949

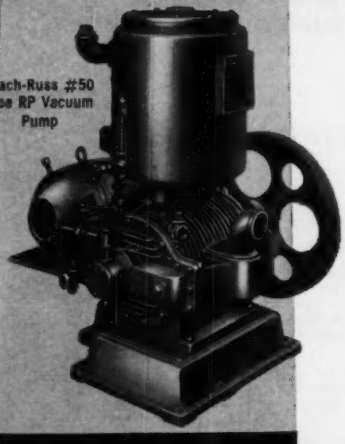
Whatever Your Vacuum Needs...

BEACH-RUSS Can Meet Them

Beach-Russ #6
Type RV Vacuum Pump



Beach-Russ Model O
Portable Vacuum Pump



Beach-Russ #50
Type RP Vacuum
Pump

Beach-Russ High Vacuum Pumps are available in a complete range of types and sizes to meet any vacuum need. From the smallest 1 c.f.m. portable unit for testing and dehydrating work, to the large 1800 c.f.m. units for process operations, these precision-built

BEACH-RUSS Vacuum Pumps

give

Fast "Pump-Down"
High Efficiencies
Quiet, Vibrationless Operation
Long Service Life

If you are planning a new installation or are in need of technical advice, get in touch with Beach-Russ.

Mail Today!

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FIRMS . . .

chemicals. The chemical program will go far beyond the formal by-product operations allied with the manufacture of coke. Dofasco hopes to participate in the production of new materials from natural and manufactured gas.

Airetool Mfg. Co., Springfield, Ohio, has started operation of its new overseas manufacturing plant in Vlaardingen, the Netherlands.

Texas Eastern Transmission Corp. has received Federal Power Commission approval for the removal of the major portion of the Little Big Inch system from natural gas service and construction of substitute facilities to maintain the company's gas delivery capacity.

First heat is under way in a new 500-kva., 3-phase furnace at **Battelle Institute's** new chemical and metallurgical laboratory for large-scale studies.

Houdry Process Corp. has placed a new Houdriflow catalytic cracking unit, first in the Orient, in operation at the Yokkaichi, Japan, refinery of the Daikyo Oil Co., Ltd., Tokyo.

Granulated aluminum ingot is being produced at **Aluminum Co. of America's** plant near Wenatchee, Wash., as part of a $175,000 expansion program.

Calaveras Cement Co. directors have approved a $4 million expansion plan which will add a fifth rotary kiln to the company's plant at San Andreas, Calif., and increase capacity by 30%.

Bankline Oil Co. plans a $3.5-4 million building program to modernize its Bakersfield, Calif., refinery.

Southwestern Engineering Co., Los Angeles, has been awarded a contract for the construction

Exact Weight Weigh Feeders Improve Plastics Production

at WOOSTER RUBBER

In making large plastic dishpans, Wooster Rubber found that this Exact Weight weigh feeder helped them produce a more uniform product, reduced rejects to a minimum, and effected a great saving in material.

These machines give exact control by weight of the amount of material required for a perfect product — eliminate flash and short shots—allow accurate adjustment for any product large or small.

Write for complete information on Exact Weight Weigh Feeders for plastic molding

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Better quality control
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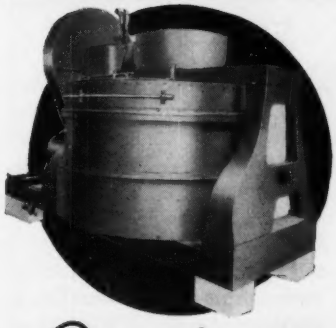
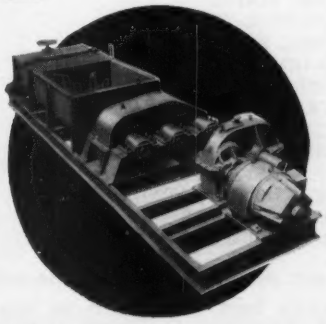
Lancaster® Equipment Solves Mixing Problems In The Mineral Fertilizer Industry



Lancaster MIXERS

Serving more than 30 diversified industries for precision batch mixing. Exclusive counter-current mixing and mulling assures uniform distribution of batch components. 7 sizes, 25 models.



Lancaster PUG MILLS

For blending, processing, and feeding fertilizers and other earth minerals of metallic or non-metallic character. Single and double shaft models in various sizes . . . and custom designed, ruggedly built to specifications.

Prices and Specifications Furnished Without Obligation.

POSEY IRON WORKS, INC.
Brick Machinery & Mixer Division
LANCASTER, PA. New York Office: Graybar Building

HART-CARTER TO EXHIBIT AT CHEMICAL SHOW

Visit Booth C-18 at the 25th Exposition of Chemical Industries in Philadelphia, December 5-9. You'll see standard operating models of Hart-Carter equipment which will demonstrate how the various types of machines size and separate free-flowing granular materials.

Get the facts about ACCURATE SIZING of granular materials

Hart-Carter machines size or separate by dimensional differences —that is, by length or by width or by thickness. These machines use (1) pocketed Carter discs or (2) indented Hart Uni-Flow cylinders or (3) Carter Precision Grader cylinders perforated with either slots or round recessed holes.

IN THE MEANTIME—

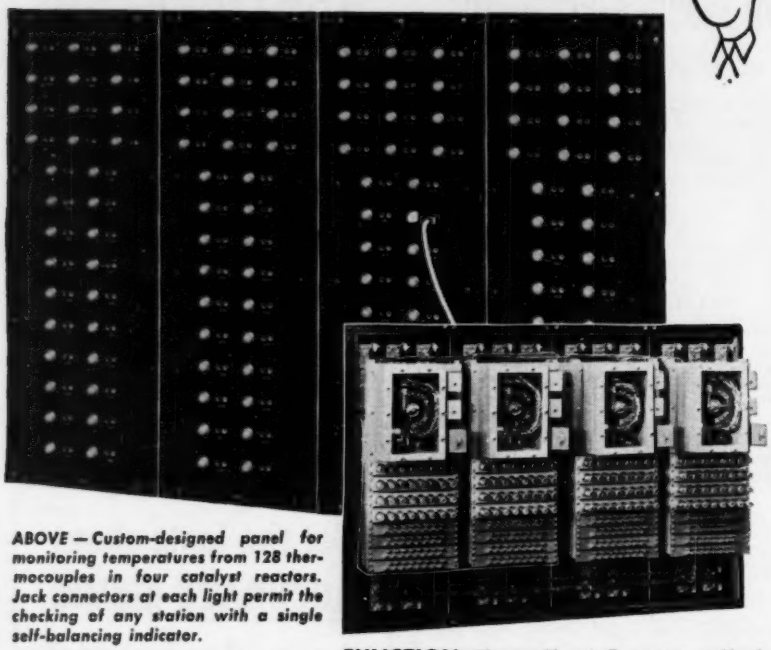
Two folders describe the principles and methods used in Hart-Carter equipment. One folder —L-1—discusses length separation. The other—CPG-2—describes sizing or separating by width or thickness. Write for these folders today.

HART-CARTER COMPANY

661 19th Ave. N.E.
Minneapolis 18, Minn.

MACHINERY FOR CLEANING AND SIZING GRAIN, SEED, AND OTHER GRANULAR MATERIALS

INTERESTED IN TEMPERATURE MONITORING SYSTEMS?



ABOVE — Custom-designed panel for monitoring temperatures from 128 thermocouples in four catalyst reactors. Jack connectors at each light permit the checking of any station with a single self-balancing indicator.

RIGHT — Rear view of above panel, showing stepping switches, sequencing relays, banks of signal memory relays and thermocouple connection strips.

FUNCTION—Thermo Electric Temperature Monitoring Systems signal dangerous temperatures (or other conditions) at any one of up to several hundred points. Employing resistance bulbs or thermocouples, these systems contain a minimum number of components—guaranteed by a single supplier —Thermo Electric Co.

OPERATION — Each sensing element is connected ot a sequence-stepping switch, controlled by an impulse timer, which steps from contact to contact and transmits the signals to a master measuring unit. A visual-audible warning system for each element positively indicates the existing condition.

TYPICAL APPLICATIONS—

FURNACES
PUMPING STATIONS
POWER PLANTS
MULTI-ZONE OVENS
ATOMIC PILES
WET-TANK PROCESSES
PROCESS LINES
CATALYST BEDS
FOOD & CHEMICAL STORAGES
FLOUR BINS
GRAIN ELEVATORS
SYNTHETIC FIBER-SPINNING POTS
PLASTIC MOLDERS
AIR CONDITIONING SYSTEMS

If you are interested in any of the products shown here, we should be happy to send you descriptive literature.

Thermo Electric News Announcements

DON'T MISS THE ISA SHOW IN LOS ANGELES— SEPTEMBER 12th TO 16th!! WE WILL BE IN BOOTH 404-405, DISPLAYING THESE ITEMS:

TEMPERATURE MONITORING SYSTEMS
TEMPERATURE CONTROLLERS
INDICATING RECORDERS
SELF-BALANCING INDICATORS
MANUAL-BALANCE INDICATORS
RECORDING CONTROLLERS
THERMOCOUPLES
THERMOCOUPLE WIRES
THERMOCOUPLE EXTENSION WIRES
CONNECTOR PANELS
QUICK-COUPLING CONNECTORS
ACCESSORIES
and

"CERAMO" . . . our latest high temperature, metal-clad, ceramic thermocouple wire

We have openings for qualified sales engineers and design engineers with electro-mechanical or instrument experience. Include résumé with letter of application. Salary commensurate with experience.

Thermo Electric Co., Inc.

SADDLE RIVER TOWNSHIP, ROCHELLE PARK POST OFFICE, NEW JERSEY
IN CANADA—THERMO ELECTRIC (Canada) Ltd., BRAMPTON, ONTARIO

FIRMS . . .

of a $750,000 platformer for the Anderson-Prichard Oil Corp. at its Arkansas City, Kan., refinery.

U. S. Hoffman Machinery Corp. has purchased the Intercontinental Mfg. Co., Inc., of Dallas, Tex.

Kerr-McGee Oil Industries, Inc., Oklahoma City, has completed its $3 million uranium processing mill at Shiprock, N. M.

Trane Co. of La Crosse, Wis., has opened its new 55,000-sq.-ft. coil manufacturing plant.

International Minerals & Chemical Corp. will build a new quarter-million dollar office building at its potash mine and refinery near Carlsbad, N. M.

Mitsubishi Rayon Co. will join with Celanese Corp. of America in setting up a joint firm to produce acetate in Japan.

McGraw-Hydrocarbon, Inc., a joint venture of F. H. McGraw & Co. and Hydrocarbon Research, Inc., has been awarded a contract for the design and construction of a $25-million chemical fertilizer plant to be built in Korea.

Spencer Chemical Co. has started on a $1.5-million expansion program in nitric acid and Spensol facilities at its Vicksburg works. The program is scheduled for completion in mid-1956.

General Electric's housewares department in Allentown, Pa., is operating a new $110,000 plant designed for treatment of industrial wastes prior to discharge.

Versenes Inc., purchased last year by Dow Chemical Co. and operated since then as a subsidiary, has been absorbed by the parent company.

Nic-L-Battery Mfg. Co. will build a battery-making plant at Phoenix, Ariz., around the first of next year.

S/K apades in industry

THE CASE OF THE PUNGENT FUMES AND THE PROCESS MAN WITH A PLAN

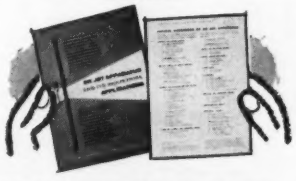
"Gadzooks!" cried Pete the Process Engineer, as he clamped a clothespin on his nose. "I dever sbelled anythig as obdoxious as doze *sulphurous fumes.*"

The *processing units* kept on fuming—and so did the employees who had to endure the odor.

"Do somethig," gasped the Plant Manager. "Those nauseatig fubes and odors are perbeating the whole fagtory. Peoble turn up their dozes at working here . . . "

Pete went into his office and held his head. A jet unit would alleviate odors and pacify his disgruntled boss. A jet unit, but what kind? And what about hoods, ductwork, recirculating system? A *jet* unit? Yes! No fan to corrode or wear out . . .

Pete wrote Schutte and Koerting for a copy of new Bulletin J-1 on "Jet Apparatus and Its Industrial Applications." That told him all he needed to know about the varieties, ranges and characteristics of Jet Apparatus.

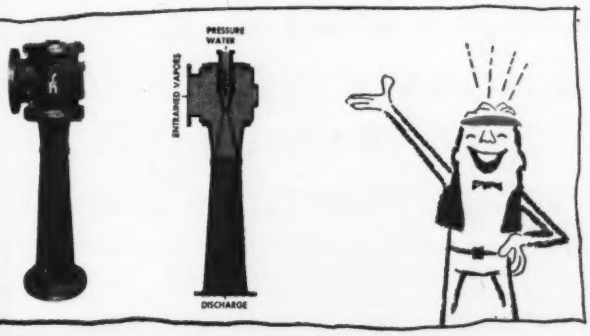


Bulletin J-1 pinpointed the data he needed. He located the desired function, the types of jets suitable for such a function, the type most suitable for his particular requirements.

Then he phoned for a specialist—his nearby SK Sales Engineer, who came a-running. And from him, Pete got a specific recommendation.

LICKED THE PROBLEM IN A JIFFY!

The SK Fume Scrubber illustrated is used to absorb sulphurous fumes in Pete's refinery. Rubber lined, the unit resists the corrosive action of the fumes. Discharge is made into a separator and clean air is discharged to atmosphere.



MORAL: *Send for a copy of Bulletin J-1 for your files. And make use of a qualified specialist on jet apparatus —your nearest SK Sales Engineer.*

Schutte and Koerting COMPANY
MANUFACTURING ENGINEERS
2217 STATE ROAD, CORNWELLS HEIGHTS, BUCKS COUNTY, PA.

Jet Apparatus • Heat Transfer Equipment
Strainers • Condensers and Vacuum Pumps
Oil Burning Equipment • Rotameters
Flow Indicators • Radiafin Tubes • Valves
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Desuperheaters

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The great mines . . . the refineries . . . the years of teamwork with all brine-using industries . . . enable International to provide the equipment, methods and know-how to make better brine at lower cost with greater efficiency . . . in any plant . . . for any industry.

From Sterling Rock Salt or Evaporated Salt

BRINE, AUTOMATICALLY MADE
. . . ALWAYS SATURATED
. . . PIPED TO ALL POINTS OF USE

For consultation without obligation, with a qualified International Industrial Engineer, write . . .

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INDUSTRIAL DIVISION • SCRANTON 2, PA.

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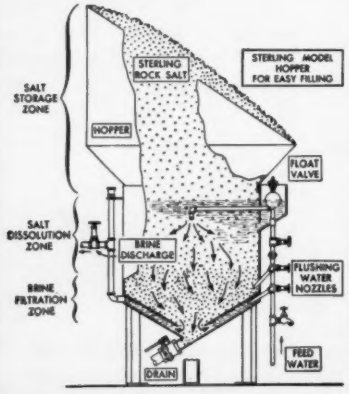
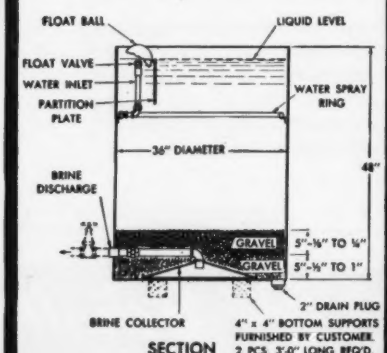
ENGINEERING OFFICES: Atlanta, Ga. • Chicago, Ill. • Buffalo, N. Y.

THE STERLING MODEL
LIXATE ROCK SALT DISSOLVER

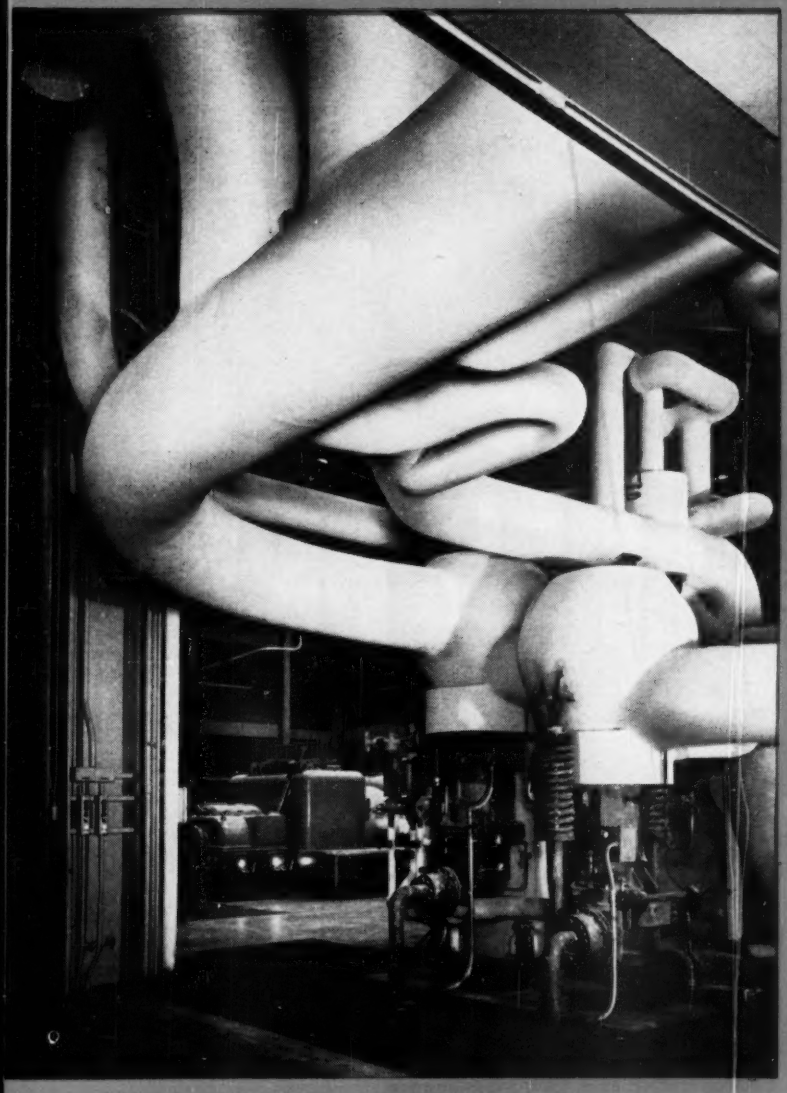


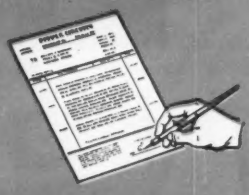
THE STERLING
EVAPORATED SALT DISSOLVER



SECTION

What do you buy when you place a *Piping Contract?*





What you really buy is performance . . . and good value for your piping dollar. And how do you get these? By selecting a piping contractor who has a reputation for quality work . . . who is called upon to do job-after-job for the same customers. It's as simple as that.

Midwest is such a piping contractor. Midwest Piping is superior piping and good value for every piping dollar. We shall be happy to have you ask us to prove it.

MIDWEST PIPING COMPANY, INC.

Main Office, 1450 South Second St., St. Louis 4, Mo.

PLANTS: ST. LOUIS, PASSAIC, LOS ANGELES, and BOSTON

SALES OFFICES: NEW YORK 7—50 CHURCH ST. • BOSTON 27—426 FIRST ST.
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TULSA 3—224 WRIGHT BLDG. • HOUSTON 2—1213 CAPITOL AVE.
CLEVELAND 14—616 ST. CLAIR AVE.
MIAMI 34—103 LEJEUNE ROAD

PIPING FABRICATORS AND CONTRACTORS FOR MORE THAN *50 Years*

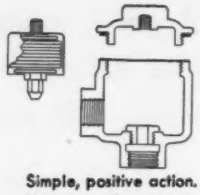
6492

MIDWEST **PIPING FABRICATION and CONSTRUCTION**

OFFERS YOU MANY BENEFITS

STEAM TRAP

Simplicity



Simple, positive action. Has only three parts —thermostatic bellows, body, cap. Won't leak!

Nicholson simplicity. Pays off big in chemical processing—in peak performance, easy maintenance. Simple in design, simple in operation, Nicholson Industrial Traps prove the most effective method for discharging condensate and air from steam lines.

- **Fast, intermittent valve action.**
- **Tight, positive shut-off.**
- **No dribbling. No waste of steam.**
- **Low operating cost. Low maintenance.**

Before you specify, check Nicholson. Write for *Catalog 953*.

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 58 PRINCIPAL CITIES

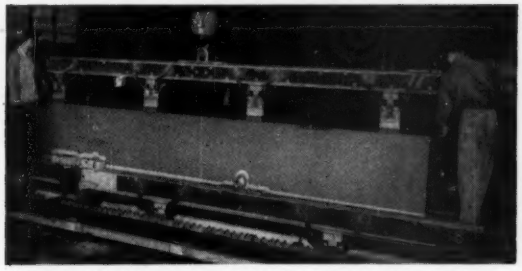
CF&I LECTRO-CLAD Nickel Plated Steel

Guards your product against contamination

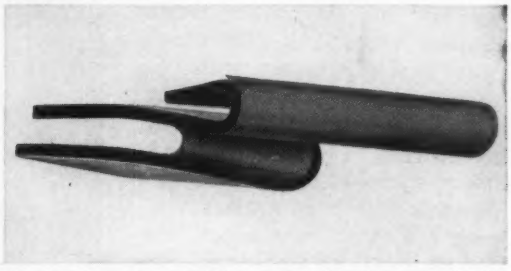
Many product contamination problems are now being solved with CF&I LECTRO-CLAD. This new nickel plated steel is being used in many heavy industrial fabrications, such as tank cars, processing equipment, storage tanks, and many other containers for products that must be kept free of contamination or discoloration.

CF&I LECTRO-CLAD's contamination control properties compare very favorably with rolled nickel-clad steel or solid nickel; LECTRO-CLAD is much better in this respect than many of the protective coatings now used on steel.

These photographs illustrate some of the manufacturing and fabricating techniques used with CF&I LECTRO-CLAD.

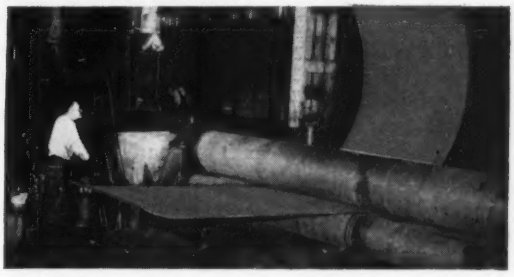


After the steel-backing material has been carefully cleaned and inspected, the nickel plating is applied by the patented Bart Process. This consists of electro-depositing a .006" to .010" coating of pure nickel uniformly over a steel surface.



After plating, the material is subjected to rigorous adhesion flame tests and a 180° bending test (shown here). These tests assure that the nickel bond will not fail even if the material is subsequently worked beyond the failure point of the steel backing itself.

CF&I LECTRO-CLAD provides the only heavy industrial nickel plating that permits fabrication by standard steel shop procedures. Here, manual arc welding is being performed on the nickel side with no damage to the plating.



CF&I LECTRO-CLAD possesses excellent working properties for rolling, forming, flame cutting, shearing and pressbrake operations. No special equipment is needed. Extreme tension or compression during forming will not disturb the nickel bond.

CF&I is now producing LECTRO-CLAD in the form of plates, sheets, pipe, heads and fittings. *For complete details, write for our new Technical Manual on LECTRO-CLAD Nickel Plated Steel.*

Claymont Steel Products

Products of Wickwire Spencer Steel Division • The Colorado Fuel and Iron Corporation

Wilmington, Delaware

Abilene • Albuquerque • Amarillo • Atlanta • Billings • Boise • Boston • Butte • Casper • Chicago • Denver • Detroit • El Paso • Ft. Worth • Houston • Lincoln (Neb.) • Los Angeles
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CANADIAN REPRESENTATIVES AT: Edmonton • Toronto • Vancouver • Winnipeg

Other Claymont Products... Stainless-Clad Plates • Carbon and Alloy Steel Plates • Flanged and Dished Heads • Manhole Fittings and Covers
Large Diameter Welded Steel Pipe • Flame Cut Steel Plate Shapes

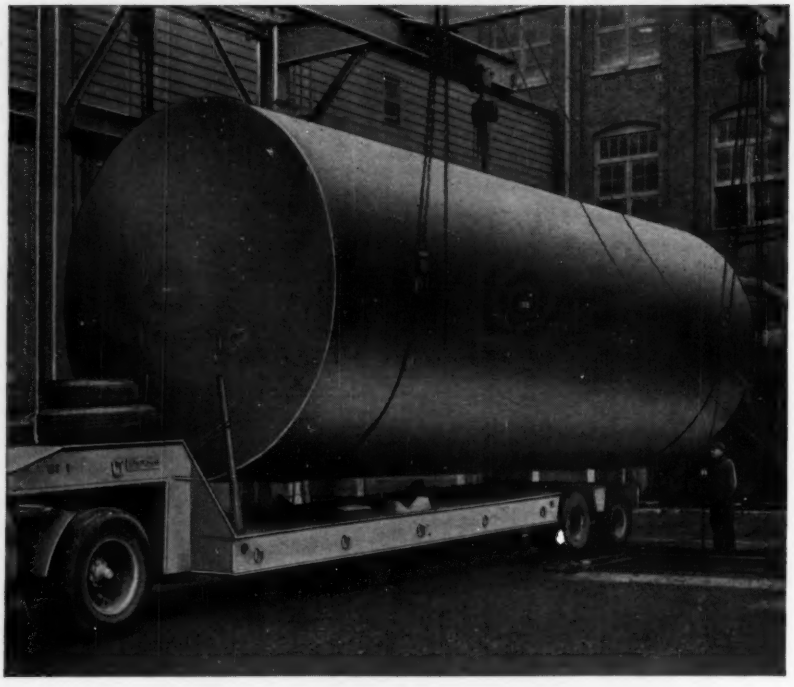
3010

HOW TO BUY RUBBER LININGS

FOR BONDED PROTECTION OF EQUIPMENT AND PROCESSES

Look for rubber linings that provide maximum resistance to acids, alkalis and temperature . . . a bond of rubber to metal that is permanent and inseparable, to guard against equipment corrosion and process contamination . . . and a company with a long established reputation, with up-to-date facilities to handle any problem you may have. Your investment in processing tank linings warrants long-lasting, dependable protection against inorganic acids and their salts. Your best assurance of longer tank life is to insist on thick, non-porous layers of rubber, rather than merely a film or coating. Tank linings should also be compounded to stand up under severe temperature extremes and present a resilient, non-breakable surface at all times under ordinary conditions of use. Look for the company that demonstrates a superior bond of rubber-to-metal. If it's so good it can't be separated without breaking, you can be sure the protection of your equipment and solution is permanent.

Specify by name the rubber tank linings specially developed to give you these advantages . . . specify Manhattan Rubber Linings.



MANHATTAN RUBBER LININGS

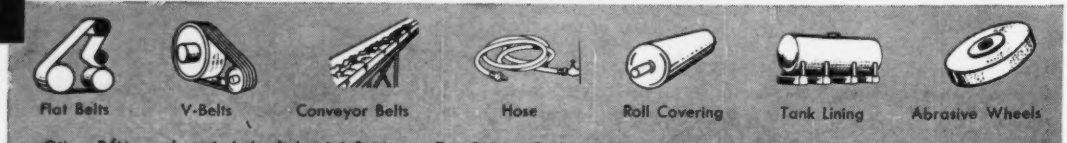
Manhattan engineers have developed a method of bonding rubber to metal so securely that tests prove it can't be pulled off. Manhattan Rubber Lining expand and contract with the metal under temperature changes without hardening or cracking. The linings provide permanent protection against corrosion and contamination because they are made of thick, calendered sheets of natural or synthetic rubber. The resistance of Manhattan Rubber Lining to most acids, caustics and alkalis is practically permanent. In addition, every Manhattan Lined Tank is tested to 15,000 volts to detect any possible imperfections . . . to make certain your tank lining offers sure, *bonded* protection for your chemical processes and equipment. Let an R/M rubber lining engineer show you why Manhattan Rubber Linings last so much longer.

RM-521

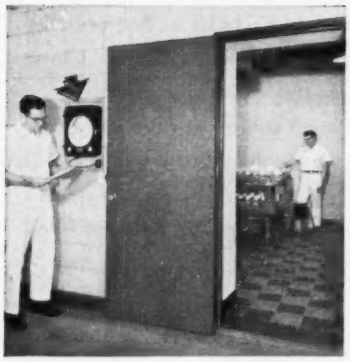
RUBBER LINING PLANTS AT PASSAIC, N. J., NORTH CHARLESTON, S. C.

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

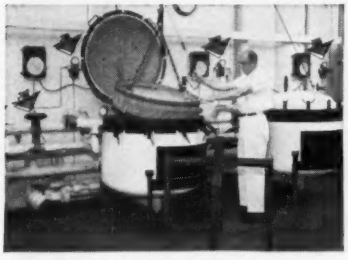
RAYBESTOS-MANHATTAN, INC.



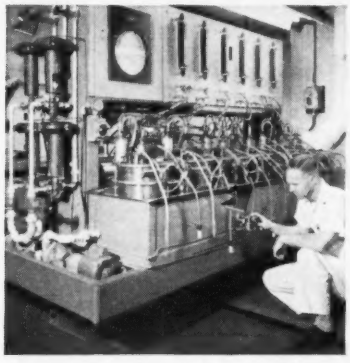
Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings • Asbestos Textiles • Packings • Engineered Plastic and Sintered Metal Products • Bowling Balls



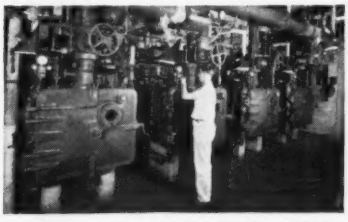
Shaker room and incubator in Fermentation Department. Powers Temperature Recording Controllers are used here.



Ampoule Sterilizers regulated by Powers No. 252 Pressure Regulators and Valves.

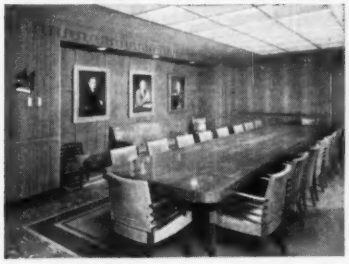


Fermentation process in research pilot plant controlled by Powers ACCRITEM Regulators and FLOWRITE Valves.



Vacuum Freeze Dryers equipped with Powers No. 26 Temperature Controllers.

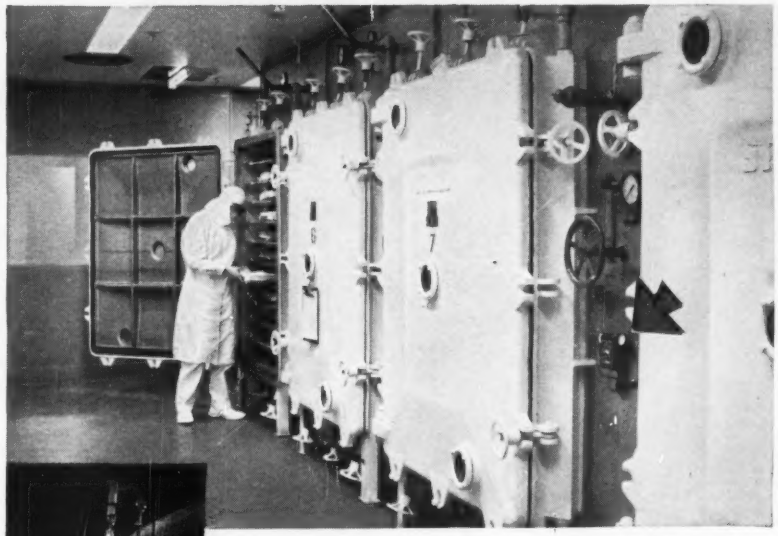
Below: Air Conditioned Room for Board of Directors and executive conferences.



POWERS

AUTOMATIC temperature, humidity and pressure control

.... helps Abbott Laboratories bring better health to millions



Many materials used in Abbott's more than 700 products are produced in the above Vacuum Dryers regulated by Powers No. 26 Temperature Controllers.

Research at Abbott's has paid off in an unbroken dividend record, numerous stock dividends and splits. Many of their famous products such as Nembutal, Pentothal, Erythrocin, Iberol, Vi-Daylin, Selsun and Sucaryl have been developed in laboratories equipped with Powers control.

Versatility of Powers control used at Abbott's is indicated by some of the applications shown here and in the following installations: Air conditioning control systems for auditorium with 900 seating capacity, executive offices and dining room, cafeteria and animal rooms; also controls for tablet machines, demineralized water heaters, autoclaves and many other applications.

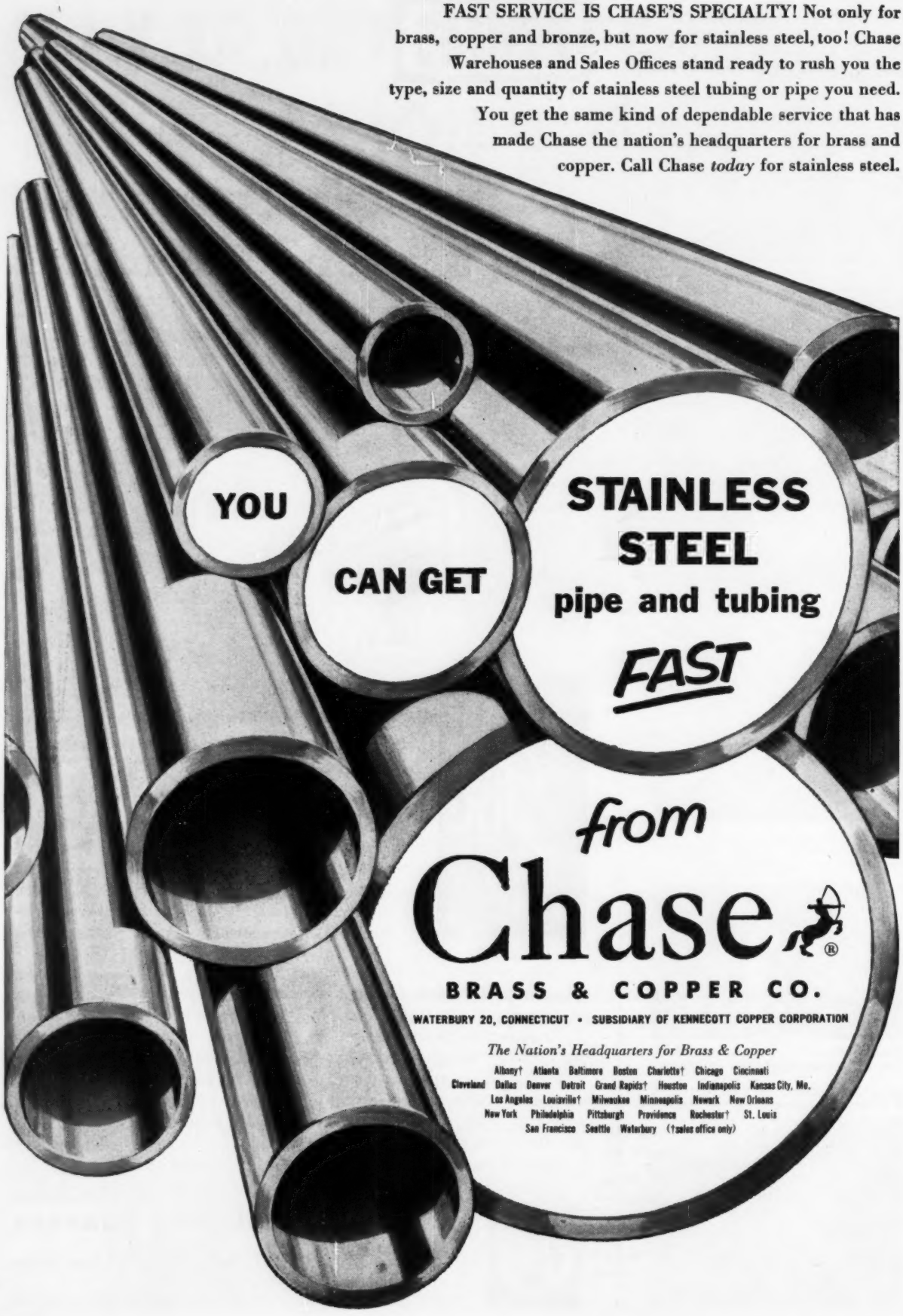
When you need automatic control for temperature, humidity or pressure, call your nearest Powers office or write us direct. An experienced Powers engineer will gladly help you select the right type of control and the proper size control valves.

(c42)

THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in chief cities in U.S.A., Canada and Mexico*

Over 60 years of Automatic Temperature and Humidity Control


YOU
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STAINLESS
STEEL
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FAST
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WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION
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FAST SERVICE IS CHASE'S SPECIALTY! Not only for brass, copper and bronze, but now for stainless steel, too! Chase Warehouses and Sales Offices stand ready to rush you the type, size and quantity of stainless steel tubing or pipe you need. You get the same kind of dependable service that has made Chase the nation's headquarters for brass and copper. Call Chase *today* for stainless steel.

If you use WAX···

···you'll want to use A-C* Polyethylene

How long have you looked for a way to get the outstanding values of polyethylene with the convenience of wax? And how many types of "poly" did you try before giving up?

Well, consider polyethylene again. But this time try *low-molecular-weight* A-C POLYETHYLENE —regular or emulsifiable!

Here's why:

- **handles at temperatures of wax in conventional equipment.**
- **gives a high gloss, enhances and adds richness to colors, improves scuff and abrasion resistance.**
- **is completely compatible with all waxes and actually fortifies all your wax formulations.**
- **permits close control of coating weight.**
- **easier to use, easier to handle. You can use higher percentages of A-C POLYETHYLENE on standard coating equipment.**

*Trade Mark

Don't delay! Commercial quantities are available for your immediate evaluation. Write for free samples today or return the handy coupon with your business letterhead.

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☐ Please send me technical literature on A-C POLYETHYLENE.

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Type of Business_____ CE-9

CONTROLLED VOLUME PUMPING with

for TOUGH fluid and gas handling jobs

ATLANTIC

FLEXIBLE METAL HOSE

Conveying nitric acid for use in batch nitrations is quick death for ordinary flexible metal hose. Sulphuric acid and plating solutions are other notorious killers. When temperature and pressure extremes and adverse handling conditions are also involved, hose replacement is frequent and expensive.

That's why—for tough jobs—it's good economy to specify Atlantic flexible metal process hose. Manufactured to survive the most destructive use, it is unequalled for leak-proof qualities, flexibility, durability, strength and lightness. It performs long after ordinary hose is scrapped and returns real savings in your material and labor dollar.

Whatever your application — conveying, controlling movement and vibration, correcting misalignments, compensating for expansion and contraction — *there is an Atlantic flexible metal hose that is best for it.*

Available in Seamless or Interlocking construction: Steel, stainless steel, monel, bronze. ⅛"—36" I.D. inclusive with appropriate fittings.

Our engineers have developed flexible metal hose for a number of classified nuclear applications. Though these types cannot be released at present, the experience gained is available for any unusual problems you may have.

Write for Chemical and Process Industries Bulletin 20D.

See our Catalogs in Sweet's Files for Product Designers and Mechanical Industries.

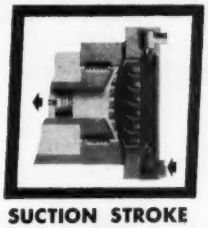
ATLANTIC METAL HOSE CO., INC.
329 Dyckman St., New York 34, N. Y.

CONTROLLED-VOLUME PUMPING with

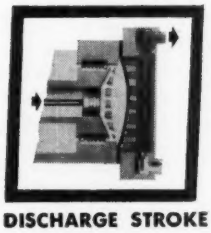
NO STUFFING BOX PROBLEMS!

Lapp PULSAFEEDER CONTROLLED-VOLUME CHEMICAL PUMP

The Pulsafeeder, in combining the good features of both piston and diaphragm pumps, provides an unusually dependable means of precision pumping. There is no stuffing box, hence the usual problems of maintenance and repacking associated with plunger-type metering pumps do not exist. The product being pumped is isolated from the pump's working parts by a hydraulically balanced diaphragm and is kept safe from contamination and leakage to atmosphere.



SUCTION STROKE

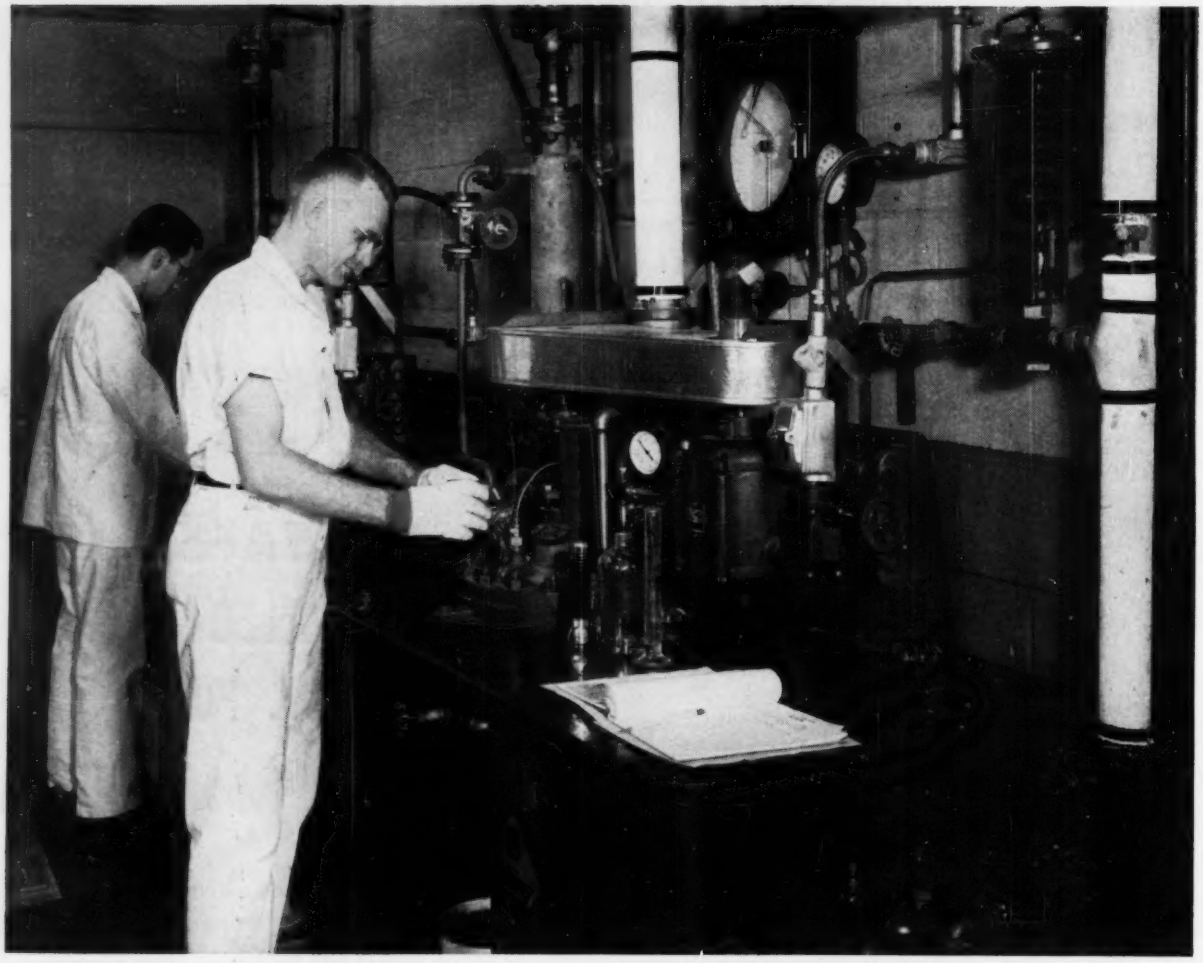


DISCHARGE STROKE

Positive displacement is achieved by a piston reciprocating within an accurately sized cylinder at an established stroke length, displacing an exact volume of hydraulic oil. By means of this oil, the piston moves the diaphragm alternately backward and forward. The displacement of this diaphragm travel takes in the liquid on the suction stroke of the piston and discharges a like amount of liquid on the discharge stroke of the piston.

WRITE FOR BULLETIN 440 *with typical applications, flow charts, description and specifications of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Division, 472 Wilson Street, Le Roy, N. Y.*

Lapp



Two of three p-k pilot plants fit compactly into the corner of Celanese's Technical Service and Application Lab. All were designed specifically for resin experimentation.

How Celanese serves its customers with the help of p-k Packaged Pilot Plants

More and more users of Celanese raw materials are asking Celanese for help in developing new and better adhesives, floorings, paints, paper, plastics, and textiles.

And, more and more, Celanese's resin specialists rely for their answers on p-k *packaged* pilot plants.

Three are at work in Celanese's big Research Center in Summit, N. J.: one for vinyl acetate monomers and copolymers; one for urea, melamine, and phenol-formaldehyde resins; and one for pentaerythritol alkyd resins. All work full time for Celanese customers.

Each is flexible enough to handle hundreds of small operating tests; accurate enough to permit projection to full scale plant operation; adaptable to the most specialized research needs; and low in price. Specifications for the unit above are typical:

REACTOR: 5 gallon working capacity • 150 PSIG design pressure • Internal cooling cylinder • Electric heater capacity of 6000 watts • Thermostatic controls • Variable speed agitator with hollow shaft for injection of gases into material • Water cooled stuffing box • Sight glasses and other extra connections.

REFLUX CONDENSER: Arranged to operate in any position. Additional condenser may be hooked up for use as a still.

RECEIVER AND DECANTER: Again, stainless steel for all interior surfaces.

The unit shown is just one of p-k's line of *standardized* pilot plants and autoclaves of 5, 10 and 15 gallon capacity and up. Each provides a wide range of temperatures and pressures for flexible operation. Heating is by steam or electricity. Internal surfaces are stainless steel.

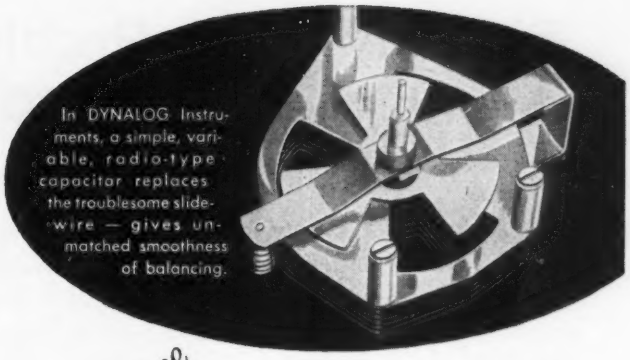
Want the full story? Send us your needs and we'll send complete specifications and a quotation, plus p-k's new catalog on equipment for the processing industries.

The Patterson-Kelley Co., Inc., 190 Lackawanna Avenue, East Stroudsburg, Pa.

PATTERSON-KELLEY

2540 B

Offices: 101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities



In DYNALOG Instruments, a simple, variable, radio-type capacitor replaces the troublesome slidewire — gives unmatched smoothness of balancing.

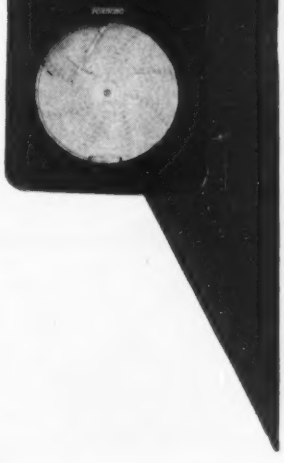
This potentiometer has no slidewire

STEPLESS CAPACITY-BALANCING

ELIMINATES SLIDEWIRE MAINTENANCE

DYNALOG'S* EXCLUSIVE BALANCING ACTION

- no slidewire
- no batteries
- no standardizing
- no gears, cables, etc.
- no high-speed reversing motor



There's no need to put up with worn slidewires and sticking electrical contacts . . . no need to periodically clean and lubricate balancing motors. DYNALOG design eliminates all this! Its simple variable capacitor and positive magnetic drive provide *continuous, stepless* balancing . . . *never* require attention!

DYNALOG's friction-free action provides high speed of response without wear. (There are only five moving parts, including the recording pen!) Sensitivity, unlimited by turns of slidewire winding, is 1/100 of 1%. And accuracy is a sustained 1/4 of 1%.

DYNALOG Instruments are available for use with resistance, voltage, capacity, or inductive type primary elements to measure and/or control any process variable . . . with unmatched smoothness. Write for Bulletin 427. The Foxboro Company, 369 Neponset Ave., Foxboro, Mass., U.S.A.

*Reg. U.S. Pat. Off.

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DYNALOG

ELECTRONIC INSTRUMENTS

Simplify Stock Problems with the AO† R5000 RESPIRATOR*

This ingenious twin cartridge respirator converts to many types of protection quickly merely by interchanging filters and cartridges. Ask your nearest Safety Products Representative. It's complete protection in one "package"!

R561 — For heavy duty protection against highly toxic insecticides such as Systox, Parathion, Aldrin, Dieldrin, Chlordane, EPN, Nicotine, TEPP and HETP. Respirator protects against all dusts, mists, metal fumes and organic vapors. Approved by U. S. Dept. of Agriculture.

R562 — For "all dusts", mists, fumes and acid gases.

R564 — For "all dusts", mists, fumes and ammonia.

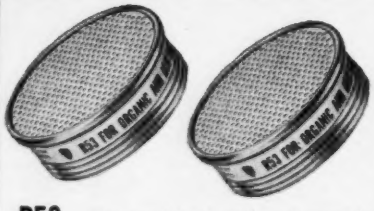
R563 — For heavy duty protection against metal burning fumes, acid gases, organic vapors—all dusts, mists.

R50 — For combination of all dusts, not significantly more toxic than lead. B.M.2156

R50A — used with R50, converts to a dust and mist respirator. Protects against all dusts not significantly more toxic than lead, pneumoconiosis-producing mists, chromic acid mists. B.M. 2156 includes B.M.2156A

R51 — For light organic vapors and gases of paint spraying, degreasing, dry cleaning. B.M.2304

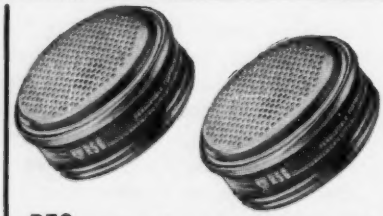
R52 — For acid gases, and mists of plating operations, pickling tanks, etc.



R53 — For combined acid and organic gases like carbon tetrachloride and acetic acid.

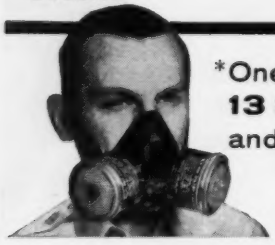
R54 — For protection against low or nuisance concentrations of ammonia.

R55 — For those who are exposed to both organic vapors and all dusts not significantly more toxic than lead. B.M.2305



R56 — For fumes produced in welding, burning, smelting and refining. B.M.2163

R57 — For dusts, mists, fumes, significantly *more* toxic than lead including radioactive particulate matter.



*One Face Piece Takes **13** Sets of Filters and Cartridges

†T.M. Reg. by American Optical Company

American Optical
SAFETY PRODUCTS DIVISION

SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES

"International" MIXERS

Tailored for the job–

But Basically Designed for Contingent Modification

After all, it's PERFORMANCE that counts. Engineers agree that efficiency comes first in profitable operation, and a Mixing unit designed for the purpose at hand (with adaptability to similar operations) will deliver superior performance and optimum results. INTERNATIONAL Mixing and Processing Equipment is preferred by Engineers because they know it is made and Guaranteed for a specific purpose—to do it better and at less cost. It's adaptability to other similar operations is an extra advantage to the user, where modification due to normal process changes become necessary. Motors, Gear Ratios, Shafts and Shaft Diameters as well as Turbine Elements are of course, interchangeable within normal limits, at minimum time and expense.

Wherever you find INTERNATIONAL Equipment you'll find a pleased user—and you'll find it in practically every segment of the Chemical, Pharmaceutical, Ceramic, Industrial and Petroleum industries. Remember to investigate "INTERNATIONAL" when you want Guaranteed Performance.

Type LFR "INTERNATIONAL" Slow Speed Turbine Type Mixer

Type GFR "INTERNATIONAL" Slow Speed Turbine Type Mixer

Courtesy, International Minerals & Chemical Corp., Bartow, Fla.

Weldforged Grating by Kerrigan Iron Works

INTERNATIONAL ENGINEERING, INC.

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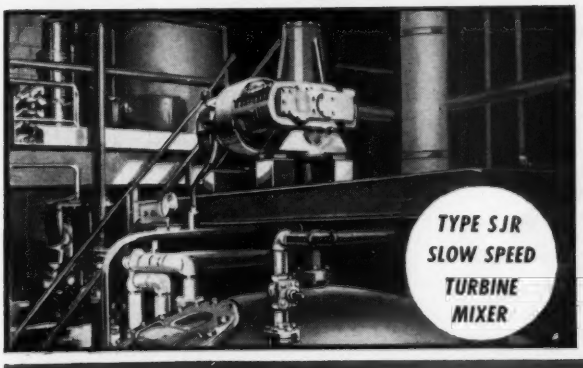
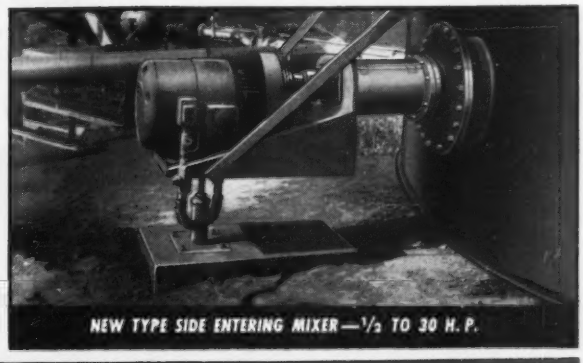
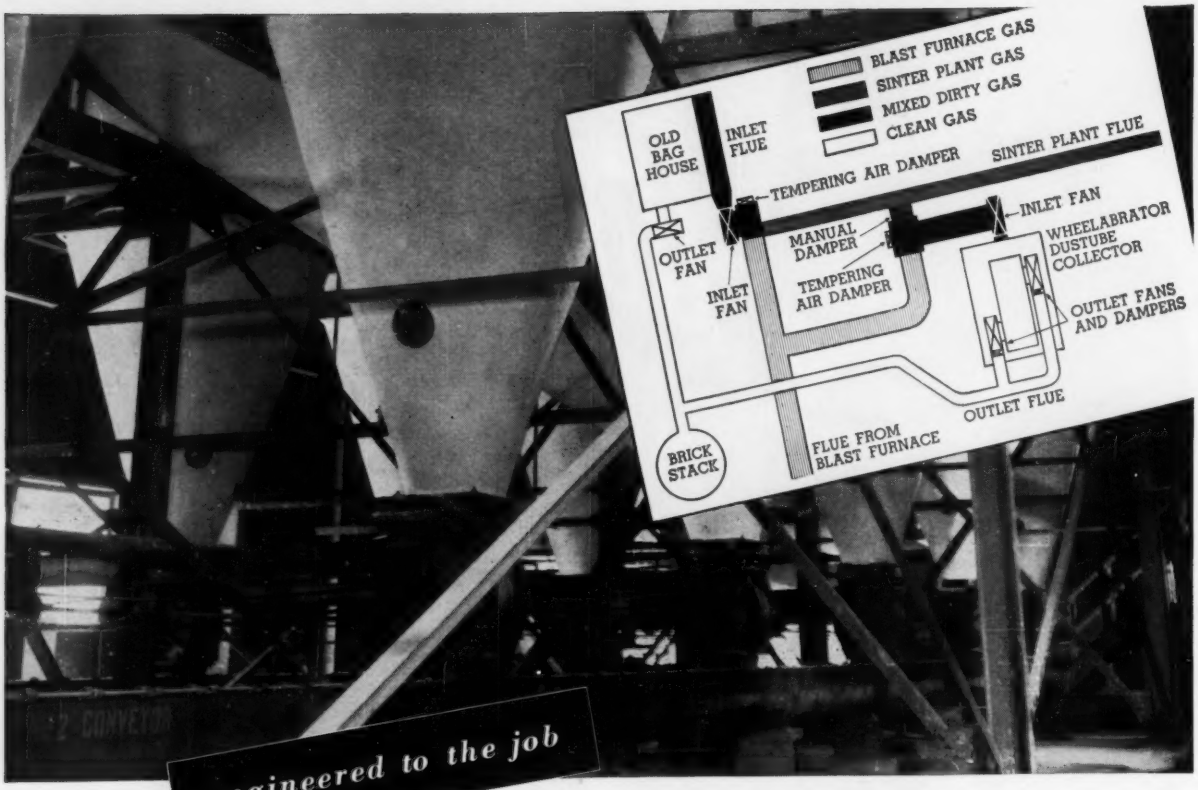
TECHNICAL BULLETINS AVAILABLE

In the interest of intelligent Engineering Cooperation, INTERNATIONAL issues Technical Bulletins on the various phases of Mixing and Processing, which will be gladly sent on request. Simply indicate the subjects in which you are interested.

Top Entering Mixers and Agitators	73-76
Side Entering Mixers and Agitators	72-A
Dry Blenders and Ribbon Mixers	78
Grinding and Mulling Fans	5-A
Portable Mixers	74-A
Mixing and Extruding Machinery	62-A
Ball and Pebble Mills	100
Continuous Mixers	A
Stack Fans and Duct Boosters	109-A
Laboratory and Pilot Plant Equipment	77-A







WHEELABRATOR® DUSTUBE® Collector

eliminates air pollution — cleans flue gas

Increase in sintering capacity, at a prominent lead smelter, necessitated an addition to the standard baghouse collection system for the filtering of flue gas from sintering machines and blast furnaces . . . and the salvage of this valuable material.

After visits to other smelters and checking on many systems, plant officials chose a Continuous Automatic Wheelabrator Dustube collector with Orlon fabric filter tubes.

The collector installed is a 12-compartment, continuous operation model. While tubes in 11 compartments are filtering, those in the 12th are shaken to drop collected material into screw conveyors for return to the sintering plant. Each succeeding compartment is automatically shaken in turn.

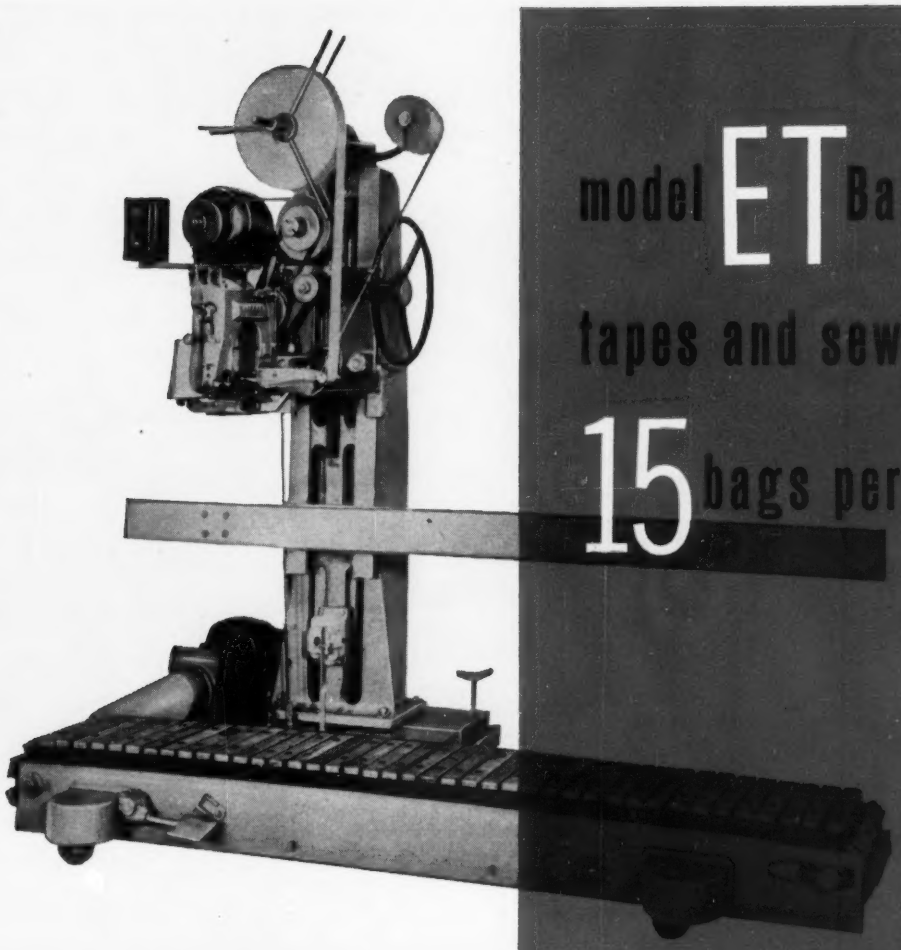
The Wheelabrator Collector was engineered into the existing system and no additional operating personnel was required. Capacity was rated at 136,000 cfm. Volumes handled have been as high as 150,000 cfm. Much improved smoke conditions have been maintained at the blast furnaces and in the plant generally and valuable material has been reclaimed. The Orlon tubes have shown no wear in a year.

To better working conditions, increase material recovery and assure a clean stack in your plant, investigate the high efficiency of Wheelabrator cloth filter systems.

Write today for your copy of Catalog No. 372 for further information.

American WHEELABRATOR® *top efficiency in dust collection*

AMERICAN WHEELABRATOR & EQUIPMENT CORP. **37 Byrkit St., Mishawaka, Indiana**



model ET Bagpaker®

tapes and sews 15 bags per minute

TAKE ADVANTAGE OF THESE 5 MODEL ET BAGPAKER FEATURES:

- One operator finishes 15 bags a minute when filled bags are delivered continuously to the conveyor
- Adjusts to bags from 25 to 100 lb. capacity
- Caster-mounted, the Model ET is easily moved to widely separated packaging stations
- Bag starts and stops sewing head when equipped with automatic sewing head control
- Automatic brake on Howpner No. 150 Heavy Duty sewing unit prevents "coasting"

Here's the perfect teammate for your present filling and weighing equipment—the most efficient way to get better protection and faster packaging at the lowest possible cost.

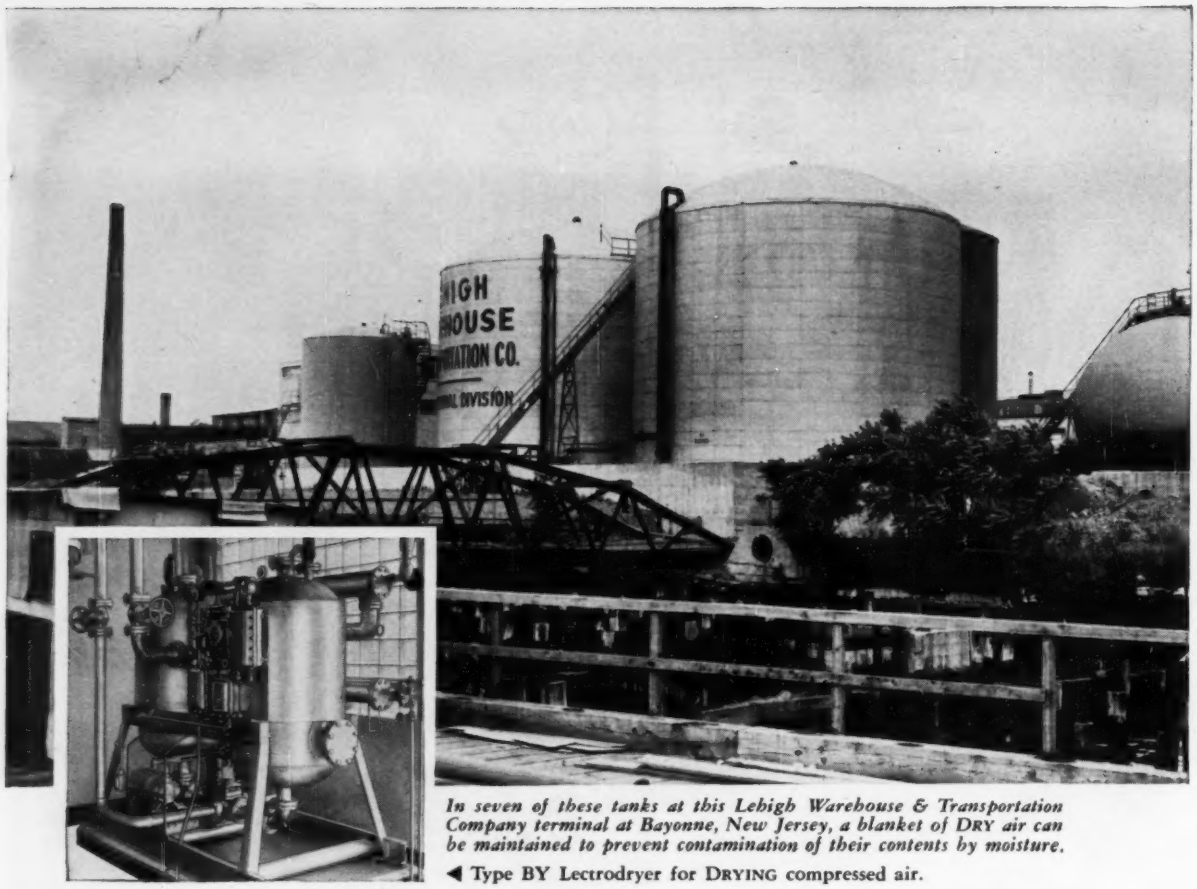
Here's how the Model ET Bagpaker works: One operator receives bags from your weighing and filling machine. In four seconds or less the Bagpaker has applied creped "kraft" sealing tape over the bag end, sewn a reinforced "cushion stitch" through both tape and bag, and trimmed the tape. You can't beat that for efficiency and speed.

Booklet ET gives you complete details and dimensional drawings, shows you how perfectly Model ET fits into your existing filling set-up. There's no obligation—just write to: E-16

International Paper Company, Bagpak Division
220 E. 42 Street, New York 17

International Paper COMPANY
BAGPAK DIVISION

BRANCH OFFICES: Atlanta · Baltimore · Boston · Chicago · Cincinnati · Cleveland · Dallas · Denver · Des Moines · Detroit · Kansas City, Kansas · Los Angeles Minneapolis · New Orleans · Philadelphia · St. Louis · San Francisco · IN CANADA: The Continental Paper Products, Ltd., Montreal, Ottawa, Toronto



In seven of these tanks at this Lehigh Warehouse & Transportation Company terminal at Bayonne, New Jersey, a blanket of DRY *air can be maintained to prevent contamination of their contents by moisture.*

◀ Type BY Lectrodryer for DRYING compressed air.

DRY air blankets products stored at this terminal awaiting trans-shipment

Tank cars arriving at this terminal are washed out with steam and then flushed with compressed air until they're dry. Thus they make certain there'll be no contamination of materials being loaded into these cars.

To safeguard any products stored here which would pick up moisture from the air above them, the tanks are kept flooded with DRY air at 30-pounds pressure. This positive pressure inside the tanks prevents infiltration of moist air from the outside. Product quality is preserved.

A Lectrodryer dries air as it comes from the compressors at 100-pounds pressure and feeds it to the storage tanks. Completely automatic, its DRYing-regeneration cycle is reversed every three hours to keep it working at top efficiency.

Whatever your DRYing problem—air, gases or organic liquids—there's a Lectrodryer capable of handling it. The book, *Because Moisture Isn't Pink,* describes installations in dozens of industries. For a free copy, write Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pa.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
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LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

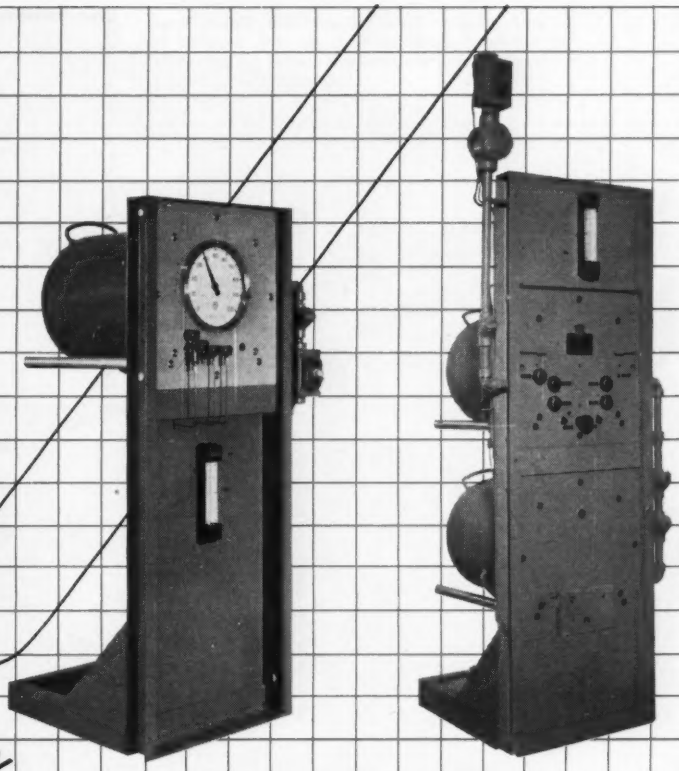
LECTRODRYER

* REGISTERED TRADEMARK U. S. PAT. OFF.

throughput up

quality up

costs down



process refractometer

(Type 38-201)

Monitors or automatically controls a process stream by *continuously* comparing its refractive index (the measure of the velocity of light through the test fluid compared to its velocity through a vacuum) with the index of a sample of *desired* composition. SEND FOR BULLETIN CEC 1839-X11.

infrared analyzer

(Type 38-101)

Handles up to five streams at a rate of 5 analyses per hour, i.e., 12-minute cycle. Increases fractionator capacity by minimizing fluctuations and holding product composition steady. Eliminates the time lag inherent in sampling and batch analysis. SEND FOR BULLETIN CEC 1840-X11.

Here are the first "Consolidated-Phillips" *continuous* process analyzers . . . units which provide analytical data while it's valid, *before* variables have changed. With these two instruments on stream, product quality and production go up . . . costs go down. You can install and maintain them for less, on an hourly basis, than a laboratory technician's salary. Both instruments are completely explosion- and weather-proof.

Consolidated-Phillips process analyzers have been proving their ability . . . and dependability . . . under actual plant conditions for several years. Originally designed and formerly manufactured by Phillips Petroleum Company, they are now backed by Consolidated Engineering's nationwide service organization . . . assurance of interruption-free operation for years to come at the pace demanded by modern refinery practice.

Whether your process instrumentation needs are for a single unit or a complete analysis-and-control system, you'll find it will pay to talk to a CEC Field Engineer. Write us today.

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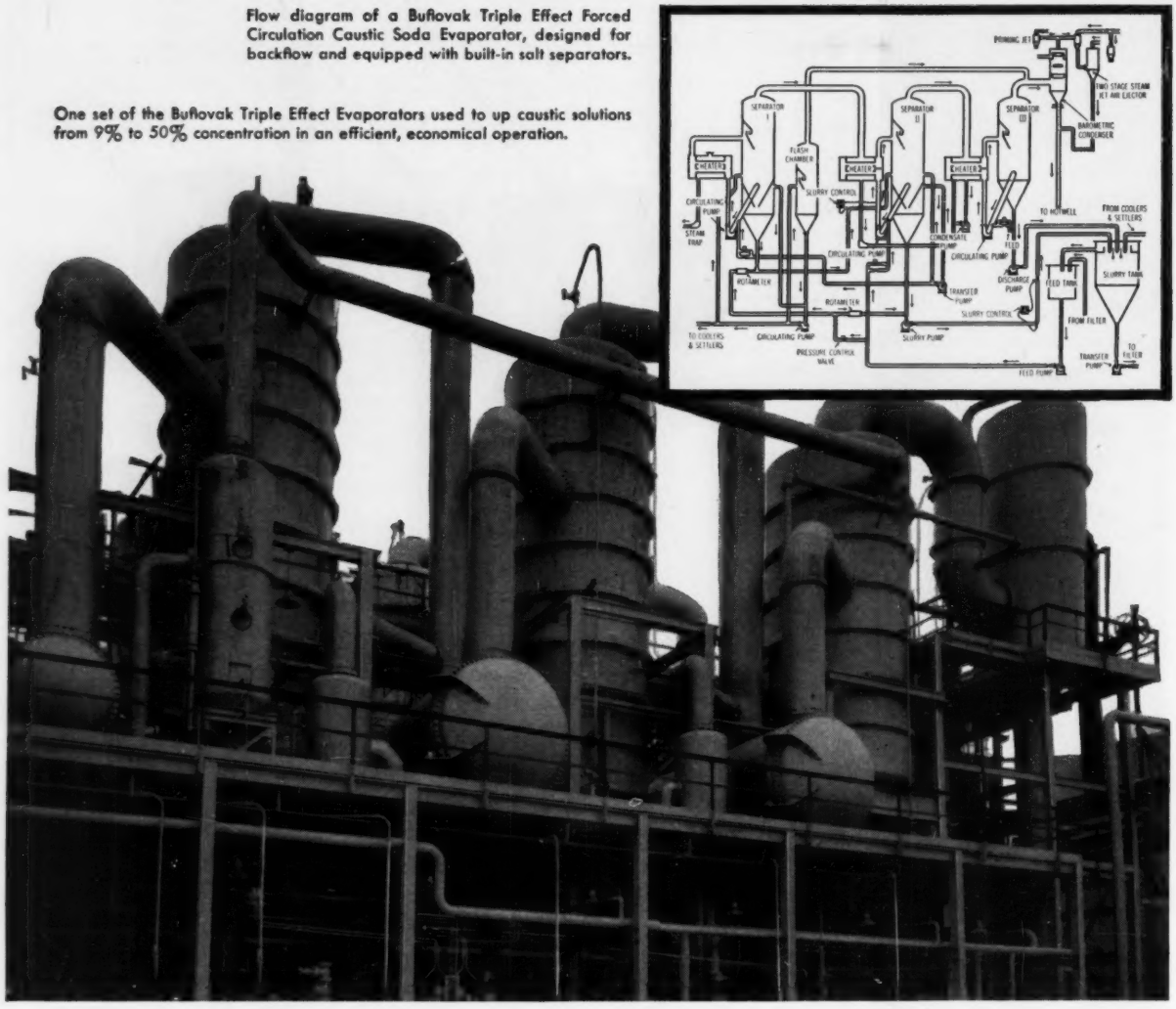
FOR MEASUREMENT AND CONTROL

300 North Sierra Madre Villa,
Pasadena 15, California

Flow diagram of a Buflovak Triple Effect Forced Circulation Caustic Soda Evaporator, designed for backflow and equipped with built-in salt separators.

One set of the Buflovak Triple Effect Evaporators used to up caustic solutions from 9% to 50% concentration in an efficient, economical operation.



Buflovak evaporation system and equipment selected

. . . for one of the world's largest NaOH concentration operations

To concentrate 9% caustic soda to 50%, a large Midwestern chemical producer chose a Buflovak System and Buflovak Triple Effect, Forced-Circulation Evaporators, Salt Separators and auxiliary equipment. This selection was based on the results of a careful study of all factors involved, from total initial investment and estimated operating costs through operational guarantees to experience and technical know-how of equipment designers and builders. Performance has equalled, and often exceeded, Blaw-Knox operational guarantees, including operational costs.

Result: Two additional installations at separate locations make this NaOH operation probably the world's largest.

Blaw-Knox Engineers have had long experience in designing and constructing evaporation and salt separation sysems for concentration and crystallization of many types of salt-bearing liquids. They can help you solve your problem, too. Why not call or write us today.

A Complete Process Equipment Service

Evaporation and Crystallization are but one phase of Blaw-Knox Process Equipment design, engineering and fabricating service for the chemical, food, pharmaceutical, plastic and resin, petroleum, rubber and other industries:

EVAPORATION • DRYING • FLAKING • IMPREGNATING
MIXING • REACTION • VULCANIZING • DISTILLATION
CRYSTALLIZATION • SOLVENT RECOVERY • STERILIZING
SOLVENT EXTRACTION • GAS CLEANING • VAPORIZATION
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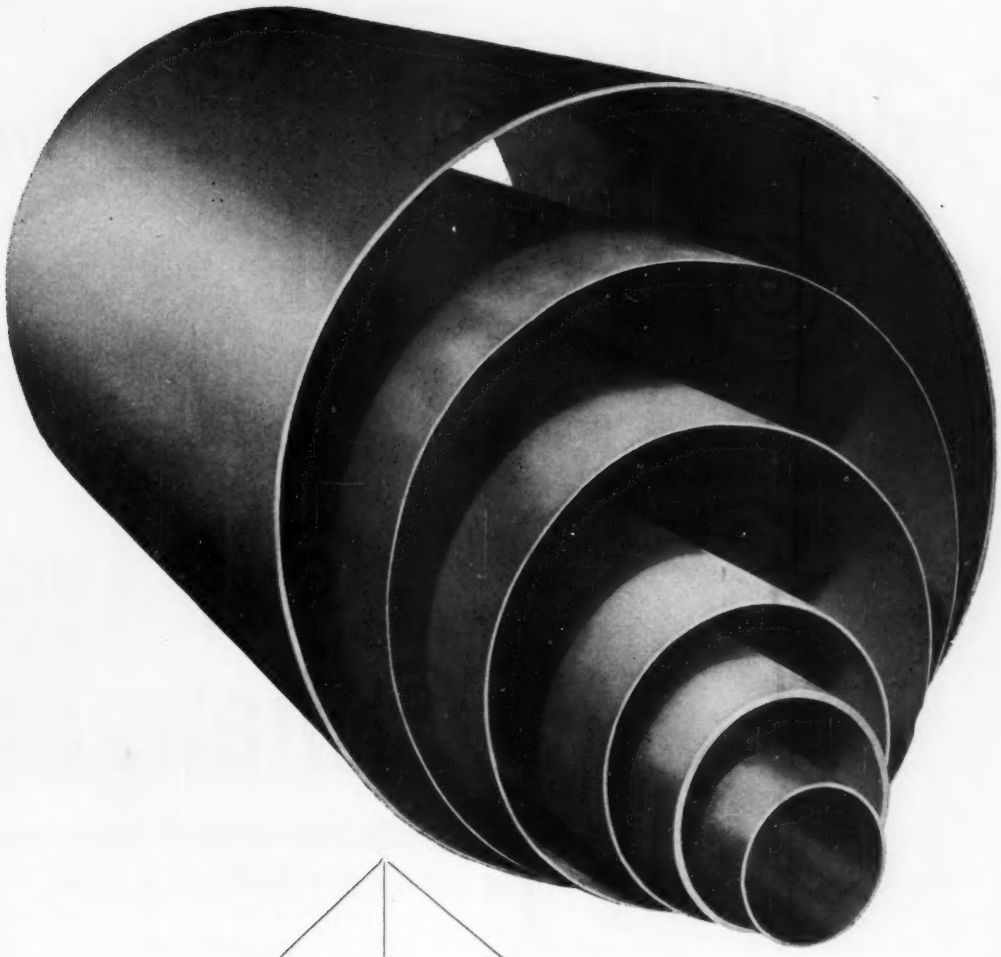
December 5-9, 1955



make it TRENTWELD

There is a Trentweld Tubing to fit all your requirements

Aircraft Tubing
Beverage Tubing
Formed Tubing
Heat Resistant Tubing
Large Diameter Tubing
Mechanical Tubing
Ornamental Tubing
Pressure Tubing
Shaped Tubing

for dimensional accuracy . . . physical uniformity

Back of TRENTWELD tubing's reputation for trouble-free service is its manufacture by *tube mill specialists.* But it is not the welding alone – it is the Trentweld process after welding that makes it superior to other tubing.

That's why TRENTWELD means accurate, uniform tubing . . . with excellent corrosion resistance . . . high strength and light weight. And TRENTWELD's smooth surface is easy to clean. It's the right choice where long life and efficient performance are needed.

Important, too, is Trent's wide range of sizes, shapes and grades – the largest in the industry. ⅛" to 40" OD are standard, and even larger sizes can be supplied if you need them. So whatever your tubing requirements are, remember, *you can't buy better tubing than* TRENTWELD.

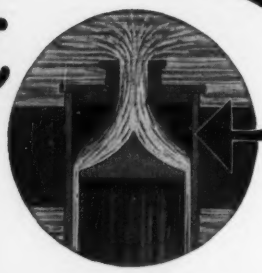
TRENTWELD

STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)

Dirty Water can't "Shut-down"...

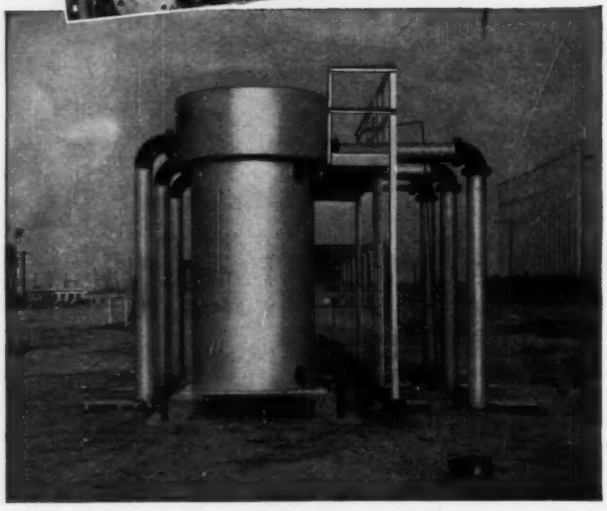
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

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- Corrosion resistance
- Immunity to thermal shock
- No metallic contamination
- High thermal conductivity
- Low first cost and low maintenance
- Workability — readily fabricated and serviced in the field
- Sturdy, durable constructions
- Standard stock units
- Complete technical service

Manufactured only by NATIONAL CARBON COMPANY

■ Only the unique combination of properties provided by "Karbate" brand impervious graphite can virtually *eliminate* corrosion, contamination and thermal shock from your processes. You'll be pleased with the hidden economies you realize after replacing hitherto "satisfactory" process units with "Karbate" equipment.

Let us bring you up to date on the latest designs in this outstanding material. And remember — your operating-cost sheets don't have to be *bad* to be *bettered!*

WRITE FOR LITERATURE!

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

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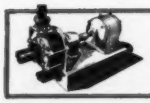
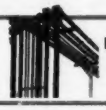
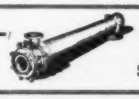
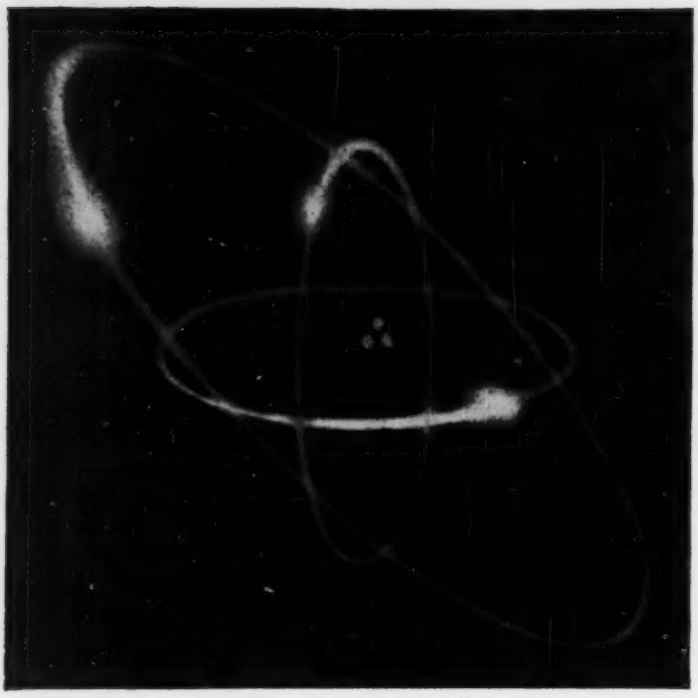

Pumps—Catalog Section S-7250


Pipe and Fittings—Catalog Section S-7000


Heat Exchangers—Catalog Sections S-6740 and S-6840

Cascade Coolers—Catalog Section S-6820

HCl Absorbers—Catalog Section S-7460



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the Miracle Element

cat'a-lyst: chem., the causing or accelerating of a chemical change by the addition of a . . . (catalytic agent) . . .

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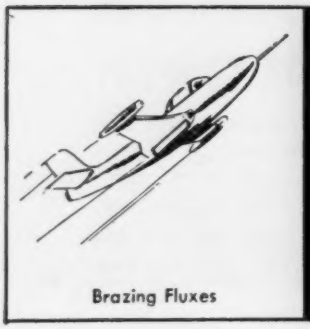
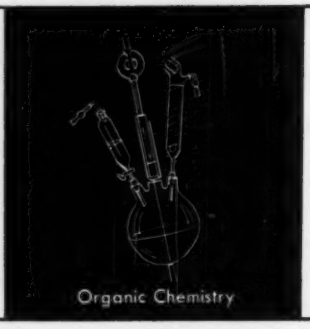
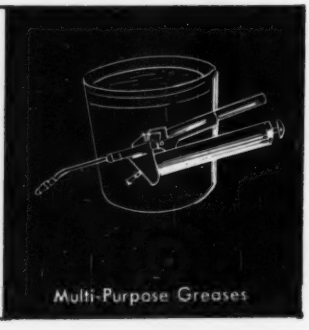


Brazing Fluxes



Organic Chemistry

Air Conditioning



Multi-Purpose Greases

. . . trends ahead in industrial applications for Lithium

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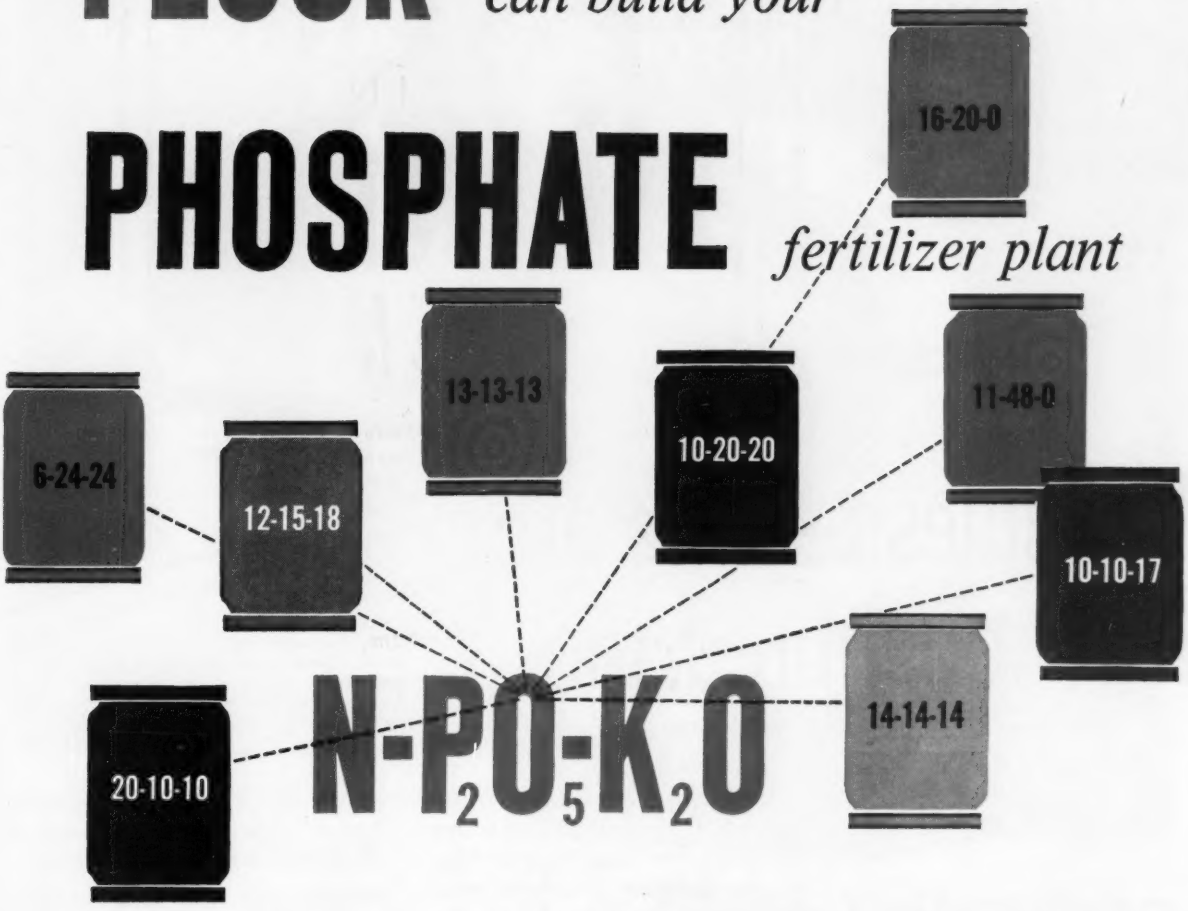
FLUOR *can build your*

PHOSPHATE *fertilizer plant*



Fluor enters the phosphate fertilizer industry through an exclusive agreement with St. Gobain of France. At a time when few men realized the vast significance of complete fertilization, St. Gobain was developing commercial processes for the manufacture of phosphate fertilizers.

In cooperation with St. Gobain, Fluor designs, engineers and constructs entire plants of any tonnage for the low-cost production of ammonium phosphates, nitric phosphates, limed ammonium nitrate, triple superphosphate, and other complete fertilizers containing nitrogen, phosphorus and potassium. The St. Gobain-U.C.B.* phosphoric acid process presents the latest advancements in phosphate rock acidulation techniques resulting in high yields and low costs.

Products are of superior quality. In particular, granulated ammonium and nitric-phosphate types are homogeneous, hard, and free-flowing materials. Varying degrees of P_2O_5 water solubility may be produced at will for the nitric-phosphate types.

A variety of fertilizer products can be made from a Fluor-designed plant. As the fertilizer market shifts its demand, the same equipment can not only produce several different formulas of the same type, but with only minor changes can be converted to produce new and different types of fertilizers. Investing in a plant that can do the work of two or three is good foresight.

In addition to the many refining and processing facilities for the petroleum, natural gas and chemical industries, Fluor has four anhydrous ammonia plants in various stages of design and construction with a total daily output of 700 tons. Fluor offers better processes and a capable engineering/construction organization to the plant food producers of the United States and Canada. We welcome your inquiry.

*Union Chimique Belge.

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stainless steels are thoroughbred, too

The experienced exhibitor rents extra stalls... leaves them empty... to prevent contamination of his thoroughbred pets by canine neighbors.

To develop their best qualities demands *exclusive* care. That is why Sun Ship's new Alloy Products Shop has been planned for the *exclusive* fabrication of stainless and alloy steel products. When you have selected from the many available Alloys a stainless steel best suited for your service condition, you have done only half the job. You must also provide for the best possible fabrication if you are to have full protection—"A Thoroughbred Job."

Why entrust stainless steel to be fabricated in the same shop where carbon steel products are fabricated, and subject this precious metal to contamination with iron fragments, dust, or other harmful elements? A segregated shop is your answer.

Sun Ship now operates an all-alloy shop, one especially built and equipped for fabricating stainless and alloy products as they should be—segregated from carbon steel fabrication.

We emphasize the fabrication of medium and heavy stainless, alloy and aluminum products for industry.

Try Sun Ship for stainless fabrication as it should be done.

Our Sales Engineering Department will be pleased to assist you with any of your fabrication problems.

Sun Ship also makes all types of carbon steel pressure vessels.

ALLOY PRODUCTS SHOP

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CAST-IRON TOTALLY-ENCLOSED MOTOR

TYPE J

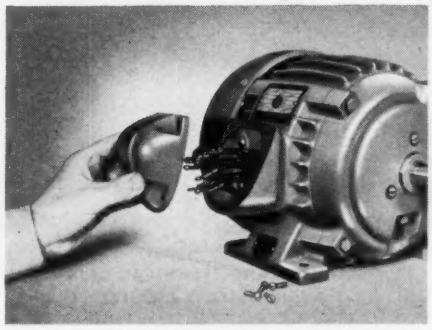
US MOTORS

NEW NEMA RATINGS

The new dimension standards recently adopted by NEMA offered timely opportunity to introduce the new Types J and E, providing more compact power, greatest safety and better value.

with

SPLIT DOME CAST-IRON CONDUIT BOX



The conduit box is a heavy duty, cast-iron, diagonally split type, neatly contoured and easiest of access. It is fitted with a special gasket and is anchored to the case with four screws. Leads are positioned, lugged and clearly marked. The box can be rotated to any of four positions.

U. S. TOTALLY-ENCLOSED

The frame, end bells, fan guard cover and conduit box of the new Type J (Totally-Enclosed) and Type E (Explosion-Proof) U. S. motors are all made of cast iron to offer complete protection against corrosive conditions and external blows. The shock-resistant, cast-iron frame is heavily ribbed for added strength and rapid heat dissipation. The iron grille is cast integrally with the fan guard. It permits maximum flow of air to the ventilating fan, prevents entrance of debris and avoids breakage. These, plus many other exclusive U. S. features such as asbestos-protected windings, Lubriflush transverse lubrication, and normalized castings, make U. S. Totally-Enclosed motors the most advanced concept of complete protection for dangerous duties.

U. S. MOTORS

Mail coupon for comprehensive fully illustrated booklet

U. S. ELECTRICAL MOTORS INC.
Box 2058, Los Angeles 54, Calif. or Milford, Conn.

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. . . from field-testing harvesters to checking jet starter performance . . .

SANBORN OSCILLOGRAPHIC RECORDING SYSTEMS prove their versatility

Research and Development

FOR INTERNATIONAL HARVESTER'S ENGINEERING TEST AND DEVELOPMENT DEPT.

A specially housed and shock-mounted Sanborn 2-channel recorder provides dynamic strain measurement data on a field forage harvesting machine, during actual field use. In the photographs, rotor shaft torque and RPM are being recorded, one of several uses International Harvester has found for the Sanborn System in field testing their farming equipment.

AT ARCH GEAR WORKS, QUINCY, MASS. . . .

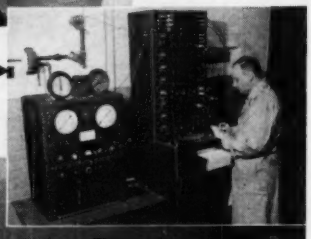
A record of tooth regularity of various types of precision gears is obtained on a single-channel Sanborn Model 141 System, used in conjunction with a special gear checking instrument devised by Arch Gear Works. The equipment permits visual spot checking of gears, helps maintain a high rate of acceptability and provides a permanent record of tests often required by customers.

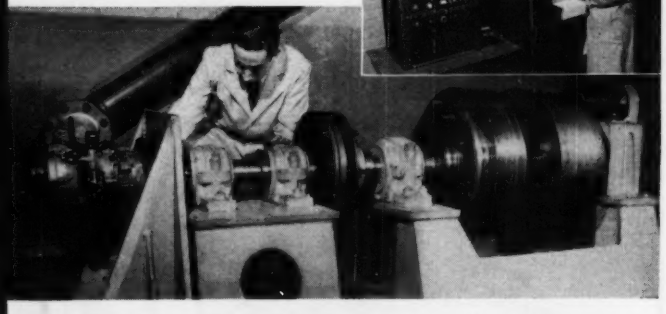
Production Testing

AT G. E.'S AIRCRAFT GAS TURBINE DIV. . . .

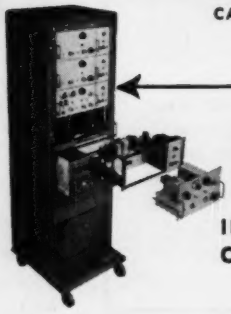
Engineers record performance data such as temperatures, pressure, RPM and starting time of jet engine starters, using a modified Sanborn Model 67 System. Six channels of information are recorded in this four-channel unit, equipped with three DC amplifiers, one Triplexer, a four-channel DC Converter, two-channel zero suppression network and two modified strain gage amplifiers. The data also provides G. E. engineers with an indication of the performance of all production units.

Research and Production Testing





These typical applications indicate the scope of usefulness of standard and modified Sanborn Recording Systems. Wherever accurate, permanent, graphic registration of electrical phenomena in the 0-100 cps range is required, the *versatility* and *flexibility* of Sanborn one-, two-, four-, six- and eight-channel systems will prove invaluable. A wide variety of readily interchangeable, plug-in preamplifiers enable *one* basic system to meet *many* recording requirements. Standard instrument features include inkless recording in true rectangular co-ordinates, high torque galvanometer movement, time and code marking, and a choice of nine chart speeds.

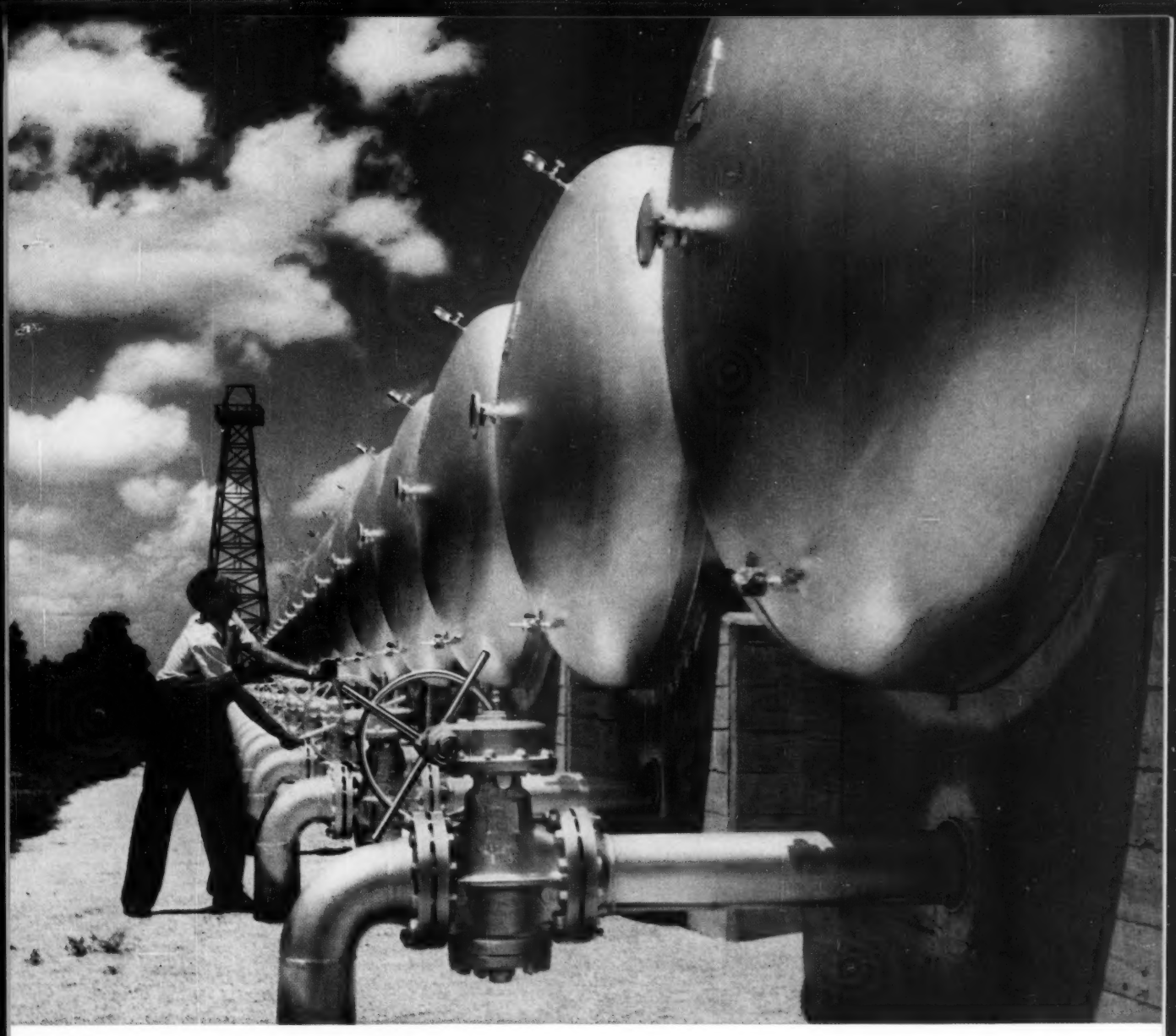


CATALOG AND TECHNICAL DATA AVAILABLE ON REQUEST

SANBORN COMPANY

INDUSTRIAL DIVISION

CAMBRIDGE 39, MASS.



Leak Proof

Sooner or later, ordinary valves leak because they depend solely upon uncertain metal - to - metal seating. Rockwell - Nordstrom valves are leak proof because the unique Sealdport* lubrication system surrounds the plug and body with a positive seal of pressurized lubricant. This penny's worth of prevention saves countless dollars in lost product, maintenance, and down-time.

Rockwell-Nordstrom, *the original lubricated plug valve*, has set outstanding performance records for forty years. Why not specify the valve and lubricant combination that has *proved* its dependability and economy. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

*a registered trademark of Rockwell Manufacturing Company

ROCKWELL-Nordstrom VALVES

LUBRICANT SEALED FOR POSITIVE SHUT-OFF

Lubricant Seating

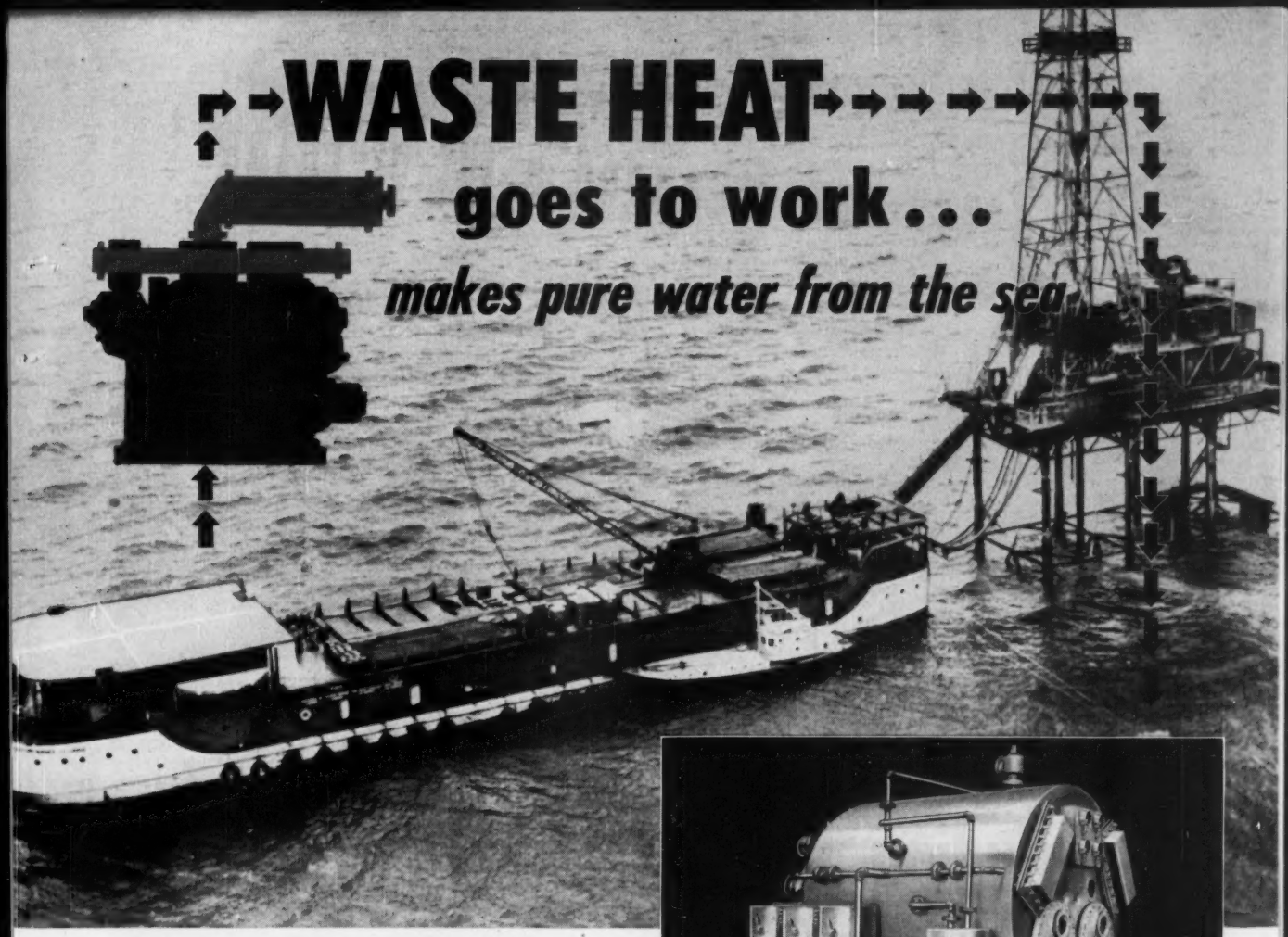
Controls Abrasive Slurries

Slurries and entrained solids raise havoc with ordinary valves. Erosion and corrosion soon cut into vital seating areas and ruin the metal-to-metal closure. This can't happen in Rockwell-Nordstrom valves because the seal is a constantly renewed film of tough lubricant under pressure. Seating areas are *never* exposed. And there are no pockets or cavities in the Nordstrom valve to collect deposits that ruin other valves.

The Rockwell-Nordstrom combination of the right valve and the right lubricant for every slurry service will give you a more dependable operation—at lower yearly cost—than any other valve you've ever used. Write today for full information. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES

LUBRICANT SEALED FOR POSITIVE SHUT-OFF

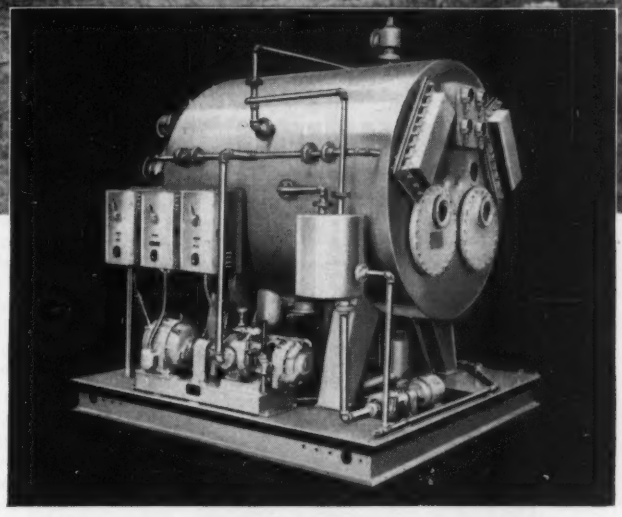


CATC and Cleaver-Brooks join to make history with potable water at zero cost

Diesel engine cooling water need no longer be wasted. It can go to work as a *valuable tool, producing low-cost pure water!* This was demonstrated recently with the launching and christening of the CATC's off-shore drilling tender, *Jack Cleverley* at the Levingston Shipbuilding Company, Orange, Texas.

This installation represents *the most modern Waste Heat Evaporator in this area of operations.* It is the ultimate in design for this type of service.

Cleaver-Brooks Company is proud to have been part of this event. We salute the CATC Group, including Continental Oil Company, Atlantic Refining Company, Tide Water Associated Oil Company, Cities Service Company and the Levingston Shipbuilding Company.



Cleaver-Brooks Waste Heat Evaporators are particularly adaptable to off-shore drilling platforms, tenders and diesel barges

Practically no scale removal. Potable water is produced from the sea at zero cost because unit uses waste heat from rig's diesel engines . . . transmitting it through heat exchangers charged with sea water. Hot water flashed into a vacuum chamber is partially converted into steam, which is then condensed on cooling coils for the output of distilled water for "mud" make-up, drinking, etc. Unit above has a capacity of 300 gph — similar units can be built to match actual water needs.

Cleaver Brooks

BUILDERS OF EQUIPMENT FOR THE GENERATION OF HEAT AND POWER

For complete details on Waste, Heat, Flash Type, Vapor Compression and Low-Pressure Steam Evaporators — for any pure water need — write: CLEAVER-BROOKS COMPANY, Dept. K. Special Products Division, 365 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. Cable Address: CLEBRO-Milwaukee — all codes.

50 Years have changed a lot of things!

...including DUST CONTROL

Cutaway view—
DAY "AC" Dust Filter

DAY "AC" FILTER RECOVERS 99.99+% and SAVES CHEMICAL PLANTS VALUABLE DOLLARS

The Chas. Pfizer and Co. Inc., is currently using eight DAY "AC" Dust Filters. DAY Self-Adjusting Blow Rings assure perfect ring-to-cloth contact. These patented cleaning rings improve filtering effectiveness, lengthen filter tube life and provide increased savings from product recovery. Write toDAY for bulletin 528-R. It explains the DAY Dust Filter in detail.

Man's accomplishments in all fields in the past 50 years are nothing short of spectacular. Compare the 12 second flight by the Wright Brothers in 1903 with the 3 hour and 46 minute *non-stop* transcontinental flight made March 9th, 1955. Striking progress in dust control equipment has also been made. When measured against the modern DAY High Pressure Reverse Jet Dust Filter, "rapping" or "shaking" type filters are simply out-of-date.

The DAY "AC" Dust Filter, made under DAY and Hersey patents, is the *modern* filter to match *modern* methods. It handles up to *five* times more dust laden air per square foot of cloth area than out-moded conventional type filters. At the same time this modern DAY Filter requires one-third less plant space.

DAY "AC" filter tubes are cleaned *automatically* and *continuously*. Self-adjusting cleaning rings clean the filter tubes and dislodge trapped dust, using high pressure reverse jet air. This cleaning method improves filtering effectiveness and lengthens filter tube life.

EVIDENCE OF DAY "AC" DUST FILTER EFFICIENCY is proven by the fact that 87% of our filter production is for reorders from users. For detailed information about the modern DAY "AC" Dust Filter write toDAY for your copy of Bulletin 528-R.

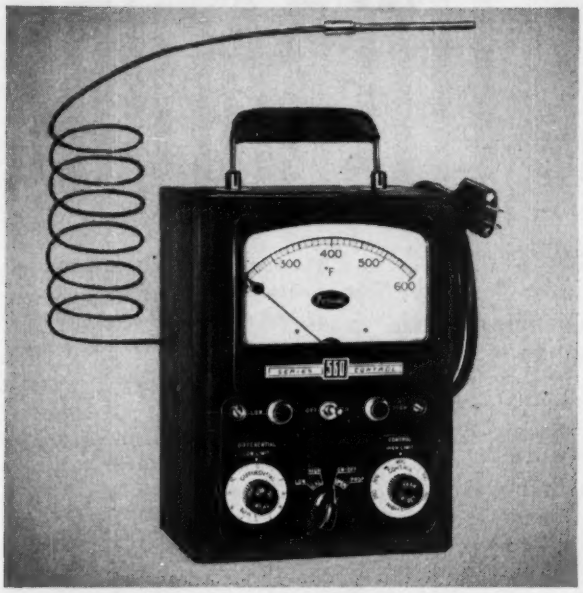
The DAY Company

856 Third Avenue N. E., Minneapolis 13, Minnesota

IN CANADA: P. O. Box 70N Fort William, Ontario
Branch Plants: Buffalo, Fort Worth and Toronto, Ontario
Representatives in Principal Cities

STOP AIR POLLUTION with DAY DUST CONTROL

Which of these two instruments provides the temperature control accuracy you need?



1. IT'S ELECTRONIC! The new Series 560 applies the thermistor principle in temperature indicator controls with heretofore unattainable accuracy over a scale range of 200° to 600°F. It's the *only* instrument that provides the three major control modes — (1) on-off (2) proportional (3) adjustable differential — all at the flip of a switch. Wide range of use for general laboratory, processing, molding or packaging applications.

2. IT'S MECHANICAL! The new Series 540 indicating controller combines low cost with high accuracy over a temperature range of 100° to 700°F. Temperature changes are transmitted by a bulb and bellows to an indicator control. Instrument features on-off control . . . adjustable differential . . . ambient compensation. May be flush or surface mounted. Capacity of 15 amps at 115 volts.

3. SIMPLICITY ITSELF is secret of Fenwal's Series 560 — accuracy, sensitivity and ruggedness. The thermistor's high resistance change permits operation with any length of lead wire up to 200 feet without affecting signal strength or accuracy. Thermistor is hermetically sealed in glass for stability; encased in stainless steel for ruggedness. No complex circuitry; maintenance is easy.

4. EASY "SET" AND "CHECK" OPERATION is a feature of Fenwal's Series 540 which is accurate to within 2% over the 100° to 700°F range, including the effects of ambient temperatures. Send for FREE NEW BULLETINS, MC122 on the Series 540, MC123 on the Series 560. Both contain full data you should have. Write to **Fenwal Incorporated, 169 Pleasant St., Ashland, Mass.**

Fenwal Controls Temperature... *Precisely*

free TECHNICAL LITERATURE

1. STANDARD PRACTICE SP-42 . . . Eight page folder listing detailed specifications for 150# corrosion resistant cast flanged valves, flanges and flanged fittings.

2. FLOW DIAGRAMS . . . Four page folder describing basic stainless steel valve designs in terms of fluid flow. Uses and limitations of each major type are discussed.

3. MATERIALS SELECTION CHART . . . Four page chart designed to assist in the selection of the most economical alloy for a given corrosive problem. More than 350 specific corrosives are included.

4. ALLOY REFERENCE CHART . . . Six page pamphlet listing alloy designations, applications, properties and analysis of corrosion and heat resisting alloys.

5. HOW TO GET THE RIGHT VALVE . . . Eight page folder giving information needed to enable manufacturer, supply company or sales representative to fit the proper valve for the application. Tells user or buyer how to get what he needs when ordering a valve.

6. THREADING STAINLESS STEEL . . . Four page folder describing specific high production machining operations on stainless steel valve parts. Speeds, cutting angles, coolants and tooling are discussed.

7. QUIKUPL STAINLESS STEEL FITTING . . . Technical manual describing design, applications and limitations of revolutionary new type stainless fittings.

8. CATALOG 55D (VALVES) . . . Sixty-eight page simplified stainless steel valve catalog includes engineering drawings, weights, size ranges, dimensions and basic material data.

9. CATALOG 55F (FITTINGS) . . . Complete stainless steel fitting catalog giving engineering drawings, dimensions and basic material data.

10. DESIGN FACTORS OF STAINLESS STEEL VALVES . . . Four page technical folder explaining basic design factors which a good stainless steel gate or globe valve should incorporate.

11. VALVE TECHNICAL DATA . . . Twelve page technical manual giving design, selection, maintenance and repair data for stainless steel valves.

12. FIGURE NUMBER CROSS REFERENCE CHART . . . Four page folder showing equivalent figure numbers of the five leading stainless steel valve producers.

13. GETTING THE MOST OUT OF YOUR VALVES . . . Four page technical discussion explaining selection, installation, inspection and maintenance of stainless steel valves.

14. PLASTIC PUMPS . . . Four page folder describing the Vanton "Flex-i-Liner" pump. Full and cut-away views, plus performance charts and material selection hints are included.

15. BUNA N AND HARD RUBBER PRODUCTS . . . Four page folder describing the Vanton line of Buna N and natural hard rubber pumps, valves, pipe and fittings. Tables, charts and other technical data required for proper selection.

16. STAINLESS STEEL VALVES AND FITTINGS IN THE PAPER INDUSTRY . . . Eight page technical article covering alloys, valve selection, design factors, installation, maintenance, operation and inspection of stainless steel valves and fittings used by the paper industry.

17. VALVES TO COMBAT CORROSION . . . *75* questions and answers selected from Cooper Alloy valve clinics covering materials, operations, service problems, installation and repair.

18. NEWSCAST . . . An eight page bi-monthly publication devoted to reporting technical material of value to those interested in corrosion resistant castings, fittings, valves and pumps.

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9	18

COOPER ALLOY
CORPORATION • HILLSIDE, N. J.

LEADING PRODUCERS OF **STAINLESS STEEL** VALVES FITTINGS AND CASTINGS

Check here for FREE LITERATURE

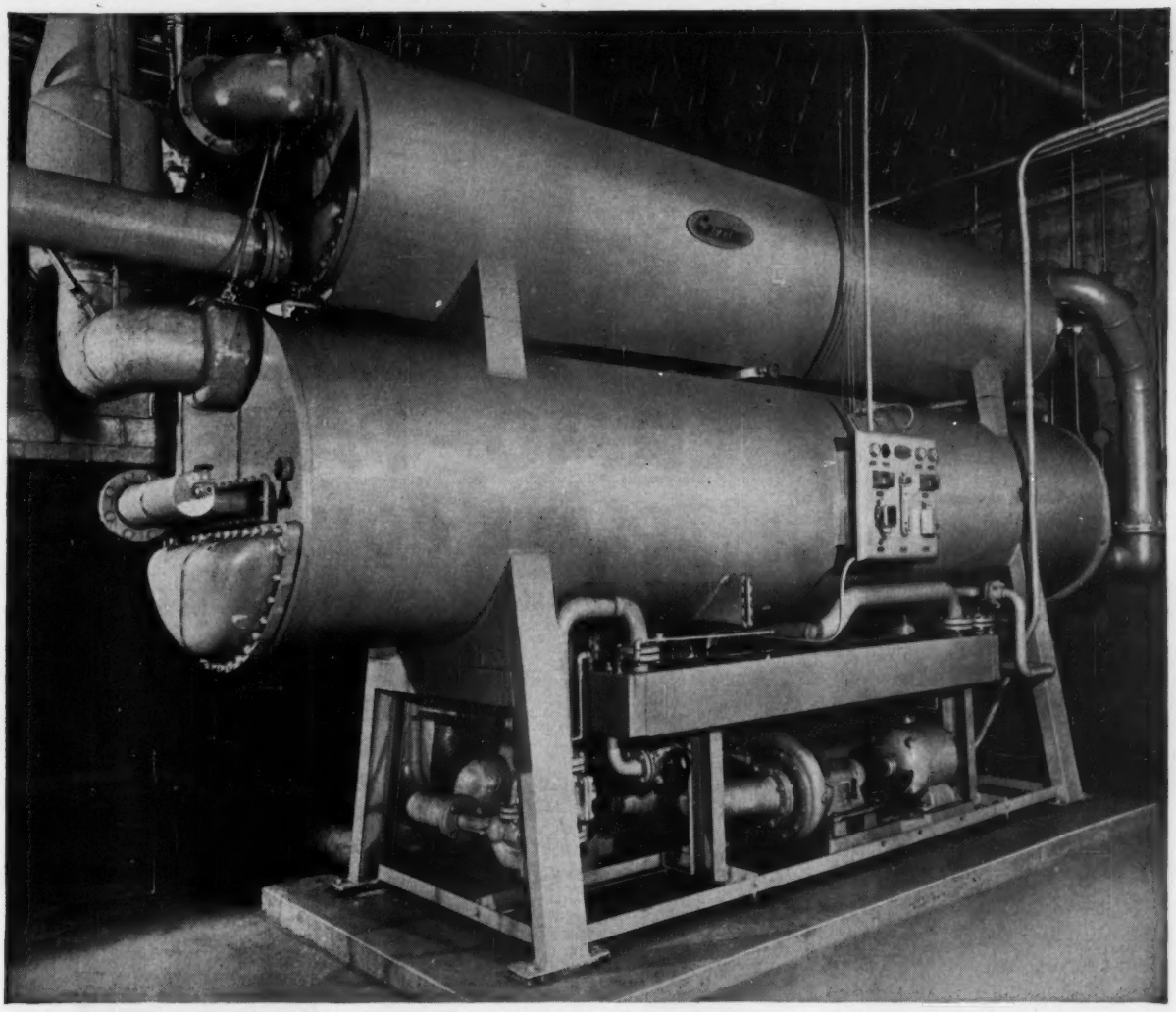
Name _____

Position _____

Company _____

Address _____

City _____ Zone _____ State _____

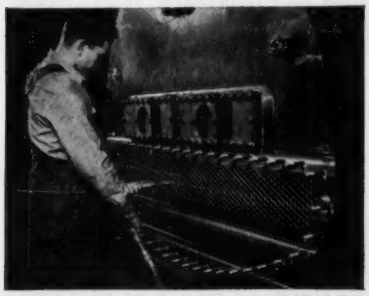


This 350-ton Carrier Absorption Machine is installed at the Joseph Horne Co. Suburban Store in Brentwood Borough, Pennsylvania.

Carrier Absorption Refrigerating Machine uses heat to cut cooling costs

—and AnacondA Cupro Nickel Tubes are again called on for economical quality performance in industry

Until recently, plant and building engineers have been hung on the horns of a cooling dilemma; how to use low pressure steam—frequently exhausted as waste—for chilling water for air conditioning and process cooling. No economical way seemed to exist to harness this heat as a work horse for cooling.



Rolling-in ANACONDA Cupro Nickel Tubes in absorber for new Carrier Absorption Machine.

Carrier Corporation, leading manufacturer of air conditioning and refrigerating equipment, found the solution in *absorption refrigeration*. In 1942, they installed the first pilot plant at the Carrier laboratory using water as a refrigerant and lithium bromide as the absorbent. Since then, a growing number of these large capacity units have been put into operation. They have few moving parts, are practically vibration-free, weigh less per rated ton, and adjust automatically to load.

Carrier selected ANACONDA Cupro Nickel Tubes for use in these machines because of their excellent service record for trouble-free performance under all operating conditions.

What are your condenser and heat exchanger problems? In selecting the proper tube alloy, the experience of our Technical Department is freely available to you. Use it as a short cut to the right solution. Write to *The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.*

54108

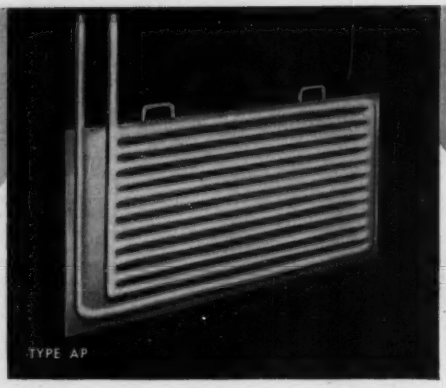
FOR EFFICIENT HEAT TRANSFER

ANACONDA®

HEAT EXCHANGER TUBES

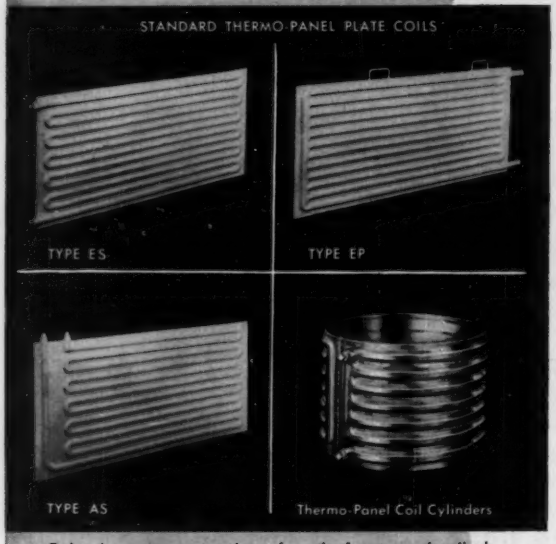
an improvement on pipe coil

more efficient
more economical
more convenient



MORE HEAT TRANSFER AREA THAN PIPE COIL DOUBLE ITS SIZE

DEAN THERMO-PANEL® PLATE COIL

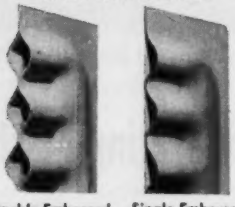


Embossing patterns at variance from the four types described are available. Consult our Engineering Department with your problem.

FASTER HEAT TRANSFER AT LESS COST

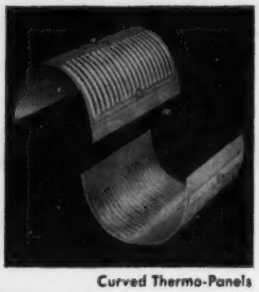
You save space and heat or cool more efficiently . . . for these scientifically designed units for which performance can be accurately anticipated are an economical replacement for pipe coils. You save almost 50% on initial cost as compared with pipe coils. You save on maintenance because they are easier to clean and can be removed from tanks without dumping the solution.

Section Through Dean Thermo-Panel Plate Coils



Double Embossed Construction

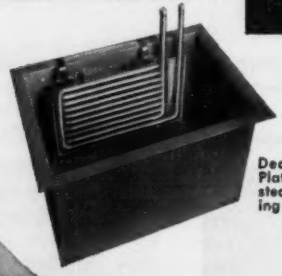
Single Embossed Construction



Curved Thermo-Panels

THERMO-PANELS
are used for
Electro-plating and Bonderizing Systems
Phosphate Coatings
Quenching Tanks
Heating and Cooling
of
Liquids, Slurries, Soaps,
Waxes, Acids, Alkalies, Electrolytes
Powders and Mixtures
Asphalts, Tars, Fats, Oils

They are also suitable as radiant heat screens around furnaces, hearths, ovens, cool-off chambers, atmosphere controlled ovens, forge presses, die-casting and injection molding machines, etc.



Dean Thermo-Panel Plate Coil used with steam to heat a plating bath.

THERMO-PANEL
DIVISION
DEAN PRODUCTS, INC. • 616 Franklin Ave., Brooklyn 38, N. Y.
Tel. STerling 9-5400

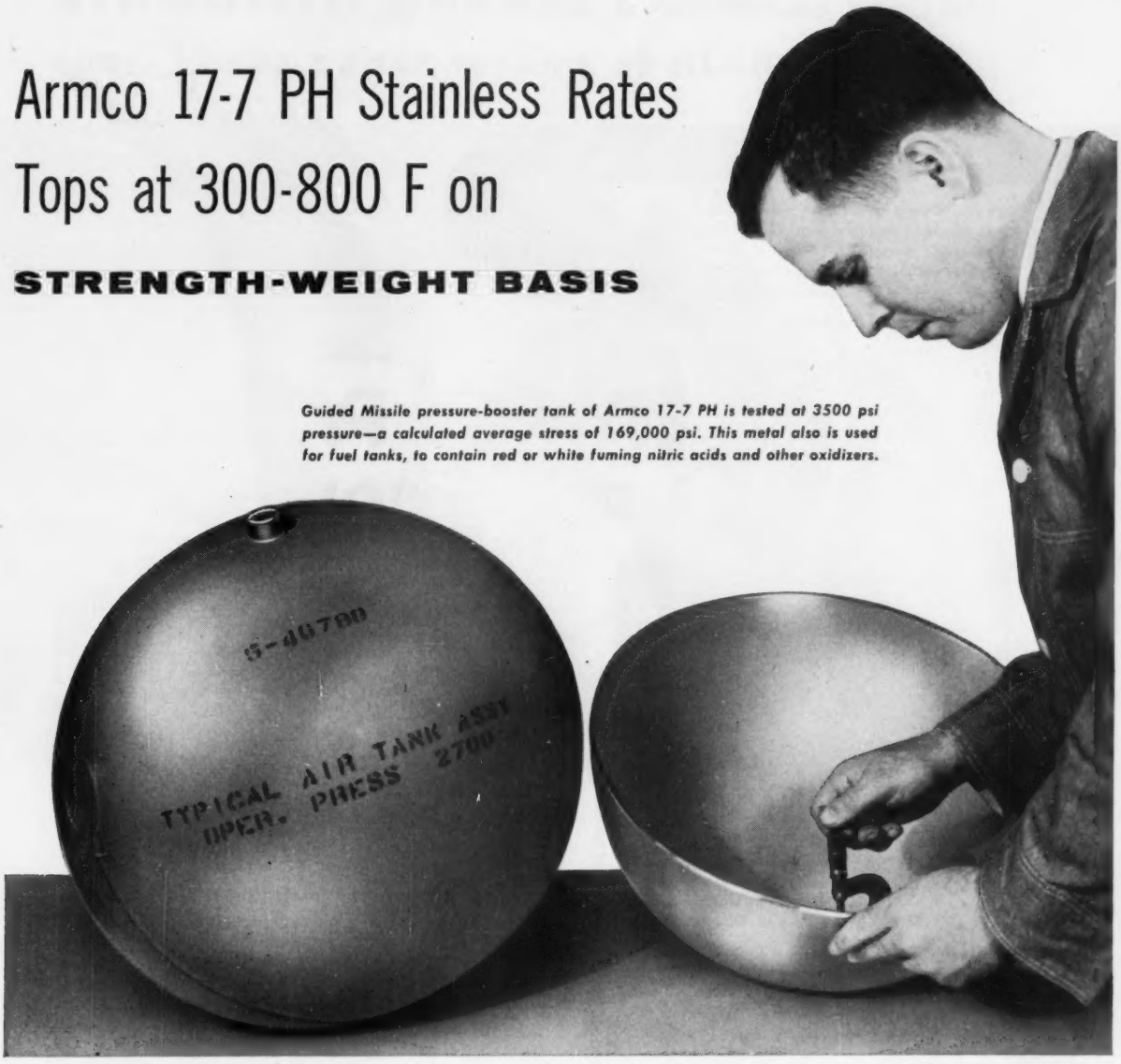
Available in special shapes such as "U"s, "L"s, and cylinders . . . and in a wide range of materials, including lead-coated iron, stainless steel, monel and other special alloys.

WRITE TODAY FOR TECHNICAL DATA BULLETIN AND PRICE LIST

SEE OUR PRICE LIST IN CHEMICAL ENGINEERING CATALOG

Armco 17-7 PH Stainless Rates Tops at 300-800 F on

STRENGTH-WEIGHT BASIS



Guided Missile pressure-booster tank of Armco 17-7 PH is tested at 3500 psi pressure—a calculated average stress of 169,000 psi. This metal also is used for fuel tanks, to contain red or white fuming nitric acids and other oxidizers.

On a *strength-weight* basis, Armco 17-7 PH Stainless Steel is unexcelled for service at temperatures of 300 to 800 degrees F. In this temperature range, Armco 17-7 PH has these pound-for-pound characteristics in comparison with the best ferrous and non-ferrous metals:

***UNSURPASSED SHORT-TIME TENSILE STRENGTH**
***SUPERIOR SHORT-TIME YIELD STRENGTH**
***HIGHER STRESS-TO-RUPTURE STRENGTH**
***HIGHER CREEP STRENGTH**

Yet Armco 17-7 PH is not a costly metal. It is well within the stainless steel price range. Besides having fine corrosion resistance, it is readily fabricated and welded in the soft condition—draws and forms much like 18-8 stainless steel. After fabrication, it takes only a low-temperature double heat treatment at 1400 F plus 1050 F to develop its high mechanical properties.

Armco 17-7 PH is supplied in sheets, strip, plates, bars, angles and wire.

For complete data, just fill out and mail the coupon.

Armco Steel Corporation, 1525 Curtis Street, Middletown, Ohio
Tell me why Armco 17-7 PH is unexcelled on a strength-weight basis for service at 300 to 800 degrees F.

Name:_____

Firm:_____

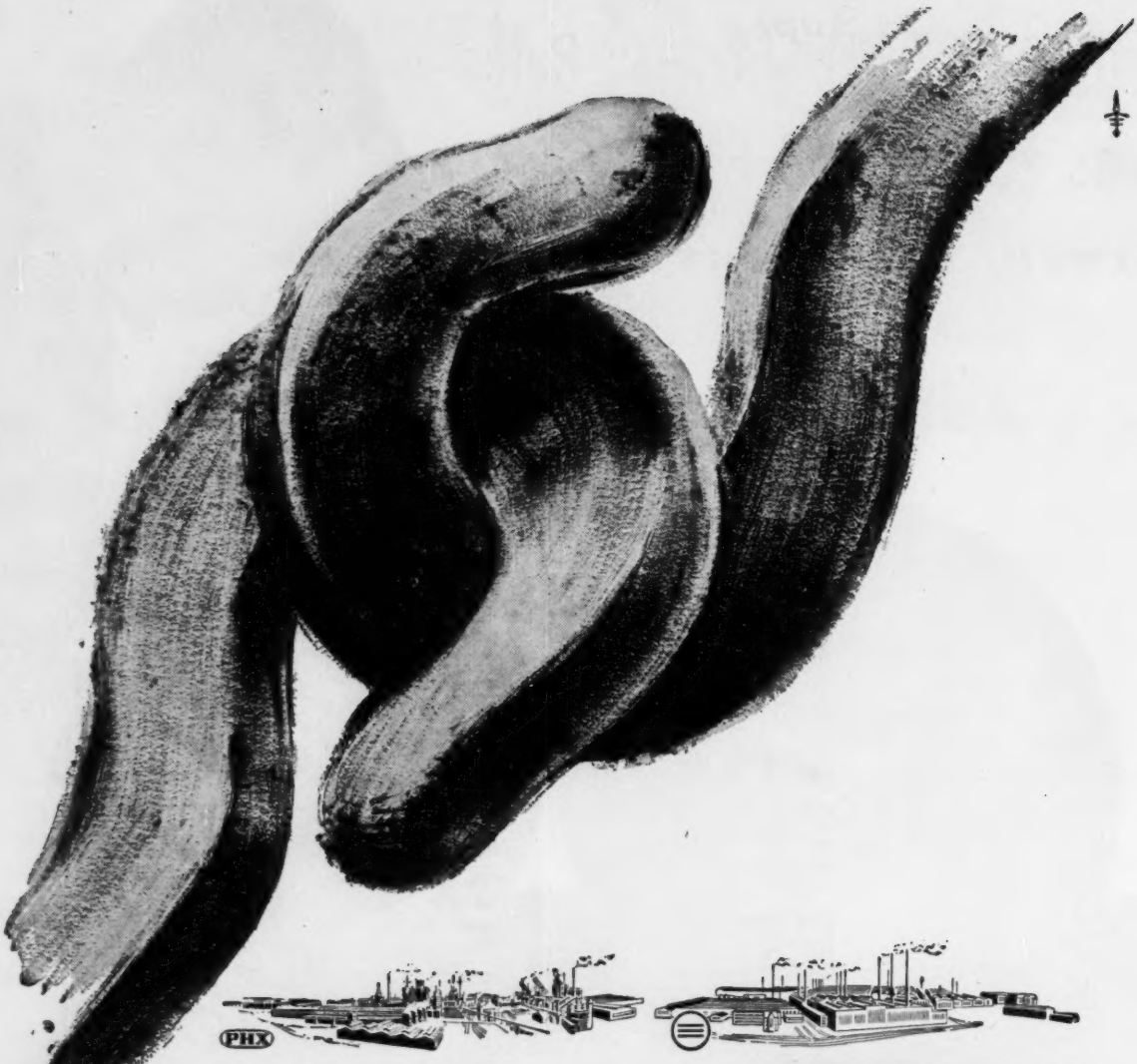
Street:_____

City:_____ Zone:_____ State:_____

ARMCO STEEL CORPORATION 1525 CURTIS ST., MIDDLETOWN, OHIO

SPECIAL STEELS

SHEFFIELD STEEL DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION



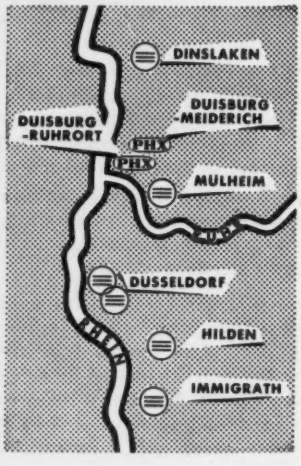
Since the days of Thyssen and Poensgen, pioneers of German heavy industry, the now joint undertakings of

PHOENIX and RHEINROHR

have served the cause of technical progress.
The payroll at our works

in the RUHR and on the RHINE

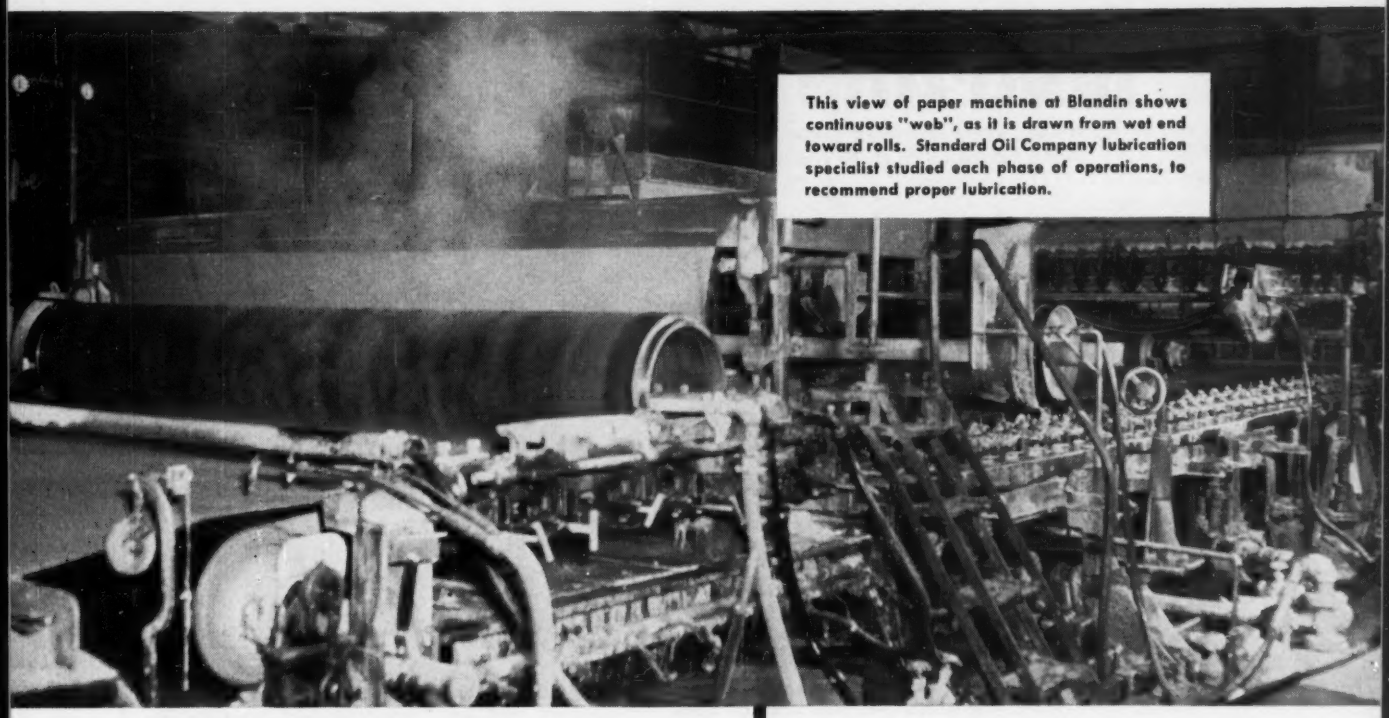
now totals 25 000 men, actively producing pig iron, semis, heavy plates and plate products, bar steel, shapes, strip steel, wide flats, permanent way materials, steel tubes, steel tubular products, Sicromal and other specialty steels, clad products. By-Products: Ground-basic slag, slag products, especially blast furnace pumicestone slag and powdered blast furnace slag.



PHOENIX-RHEINROHR AG

VEREINIGTE HÜTTEN- UND RÖHRENWERKE DUSSELDORF-GERMANY

STANOLITH GREASE *overcomes trouble spot, keeps paper rolling at* BLANDIN



This view of paper machine at Blandin shows continuous "web", as it is drawn from wet end toward rolls. Standard Oil Company lubrication specialist studied each phase of operations, to recommend proper lubrication.

STANOLITH Grease aided the solving of a rough lubrication problem at Blandin Paper Company in Grand Rapids, Minnesota.

A bottleneck on the paper making machines threatened production at this hustling paper plant four years ago. The trouble occurred near the beginning of the process, where the pulp contains up to 99% water. At this point, bearings are greeted by a shower of water and stock.

Greases were quickly lost, literally washed away. Bearings were ruined early in life. Not only had greases failed in their duty but they caused paper staining.

A Standard Oil lubrication specialist recommended STANOLITH Grease for use on the wet end of the paper machine. It did such a good job that Blandin maintenance personnel put this multi-purpose grease to work on other applications, too. Now, except when open gear and brick greases are required, STANOLITH serves the entire plant, replacing a wide number of single-duty products.

STANOLITH is truly a multi-purpose grease. It may be used almost anywhere on the job, in mechanical or hand-operated dispensers. STANOLITH Grease is heat and water resistant. It will reduce grease inventories, eliminate waste and prevent costly application errors. Find out more about how STANOLITH Grease can help you do many tough lubrication jobs with just *one grease!* In the Midwest call your nearby Standard Oil lubrication specialist. Or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Blandin maintenance man, Fred Harwood (left), and I. A. Westerlund, Standard Oil lubrication specialist, inspect a table roll bearing. This is just one of many places in the plant where STANOLITH Grease provides top-efficiency lubrication.

I. A. Westerlund is a graduate of the University of Minnesota with an engineering degree. He is also a graduate of Standard's Sales Engineering School, and makes good use of his training in providing technical service to customers. He's been doing this for 14 years. His customers find this experience and training pay off *for them.*

STANDARD

STANDARD OIL COMPANY (Indiana)

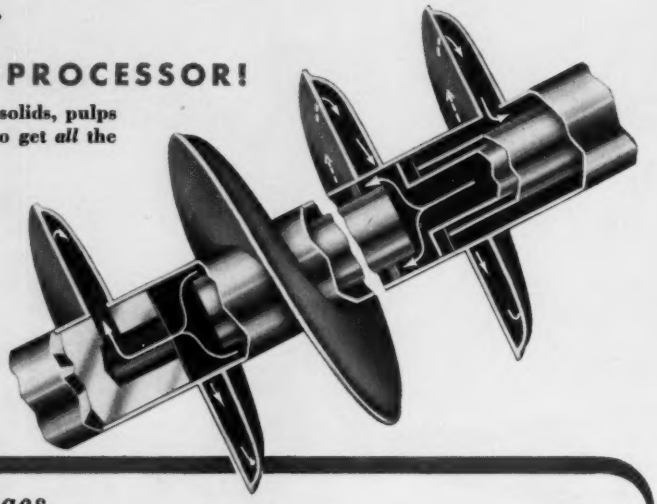
if you have a Cooling . . . Heating . . . or Drying problem

investigate the revolutionary advantages of . . .

THE holo-flite* PROCESSOR!

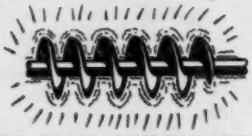
If you have processes where slurries, granular solids, pulps or pastes are cooled, heated or dried, be sure to get *all* the facts on HOLO-FLITE advantages.

HOLO-FLITE handles such processes — *in continuous flow* — in as little as 1/5th the space of other types of heat exchangers. What's more, it is readily adaptable to a wide range of applications — is simple to install and maintain — and provides many other important savings.

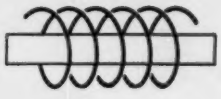


typical HOLO-FLITE *advantages . . .*

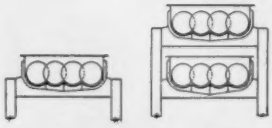
ITS APPLICATION FLEXIBILITY is almost unlimited. It cools, heats, or dries. It handles granular solids, pulps, pastes, slurries and fluids with equal ease. Its heat transfer agent can be water, refrigerant, hot oil, Dowtherm, steam or other liquids or vapors at any of a wide range of temperatures. It cools materials in ranges from 1800°F to 0°F. It heats and dries with hot oil to 600°F . . . with Dowtherm to 750°F . . . with steam to 150 lbs. per sq. in. pressure.



THE LARGE HEAT-TRANSFER SURFACE saves space — HOLO-FLITE requires as little as 1/5th the space of other heat-exchange equipment of comparable capacity. Moreover, a more complete heat transfer is effected, resulting in more uniform processing.



ROTATION IS SLOW — granular and powdered solids are handled with practically no dusting — negligible abrasion. There are no dust recovery problems — a further saving in installation, maintenance and operating costs!



ITS OPERATING CAPACITY is readily adaptable to virtually any requirements by simply varying the diameter, pitch, and length of flights, as well as the number of "tiers." Multi-tier units require no more floor space than single-tier installations!

HOW HOLO-FLITE WORKS . . .

Basically the HOLO-FLITE consists of one or more flights of hollow-bladed screw conveyors. The product to be processed moves through a trough housing the conveyor screws. The heat-transfer fluid circulates through the hollow blades and shafts of the conveyor. The product is constantly rotated into, around, under and over the blades and shafts through which the heat-transfer fluid is circulating, assuring quick, uniform heat passage between the two mediums — *as the product is continuously moved along in a bulk-flow without interruptions!*

GET THE COMPLETE FACTS on Holo-Flite savings and how this field-proven unit can save space, time and money on your processing operations. This eight-page descriptive bulletin will gladly be sent on request. No obligation, of course!

WESTERN Precipitation CORPORATION

DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1013 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
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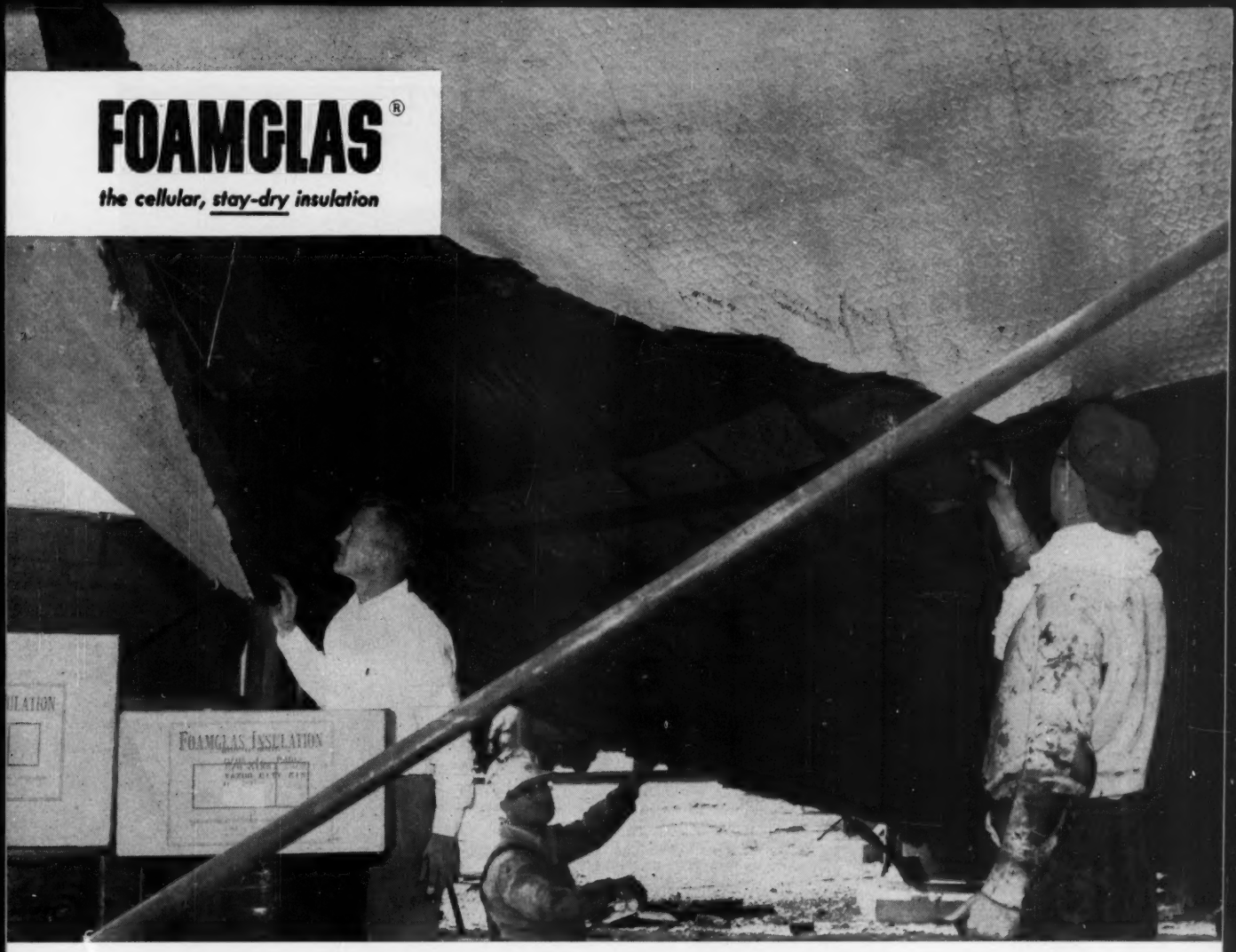
3252 PEACHTREE RD. N.E., ATLANTA 5 • HOBART BLDG., SAN FRANCISCO 4
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

* T.M. Reg. (Hollow-Flite)

FOAMGLAS®

the cellular, stay-dry insulation



Mississippi Chemical Corporation reports . . .

"Long-lasting, stay-dry FOAMGLAS replaced failed organic insulation on our ammonia storage sphere"

Organic insulation on a 34°F. ammonia storage sphere failed in less than 4 years . . . so Mississippi Chemical Corporation replaced it with long-lasting, *stay-dry* FOAMGLAS. William B. Dunwoody, General Operations Manager at Mississippi's Yazoo City plant says:

"Moisture penetration and migration ruined the original organic insulation. We had to find a truly waterproof insulation to replace it. We picked FOAMGLAS because we know its sealed glass cells simply can't absorb or transmit moisture in any form.

"We reinsulated the 48 ft. diameter sphere in sections in order to keep it in continuous operation. As each section of failed insulation was removed, it was immediately replaced with FOAMGLAS. That meant that the new insulation had to be stored in the open nearby —and it rained nearly half the time the work was going on. Pouring rain never harmed the FOAMGLAS . . . proving to us that this remarkable insulation *is* completely waterproof. We're sure that it will give us long-lasting, dependable insulating performance without costly maintenance and repair," concludes Mr. Dunwoody.

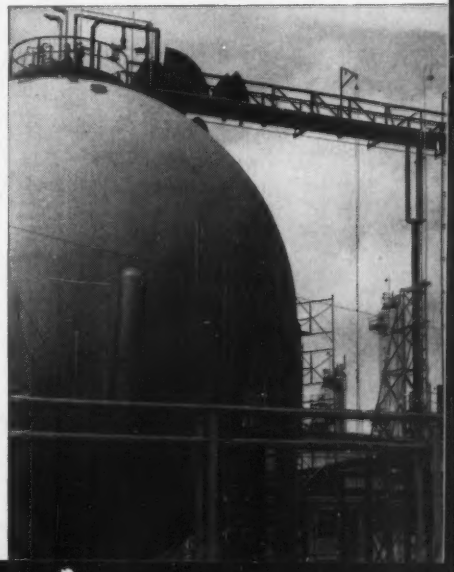
Let Mississippi Chemical's experience be *your* guide to constant, highly efficient insulating performance with *stay-dry* FOAMGLAS. This unique cellular glass insulation is completely inorganic, cannot rot or deteriorate. It is fireproof and acid-proof. It will give you the maintenance-free insulating performance you need for your piping, tanks, spheres and other industrial equipment. Why not send today for a sample and our detailed, descriptive literature.

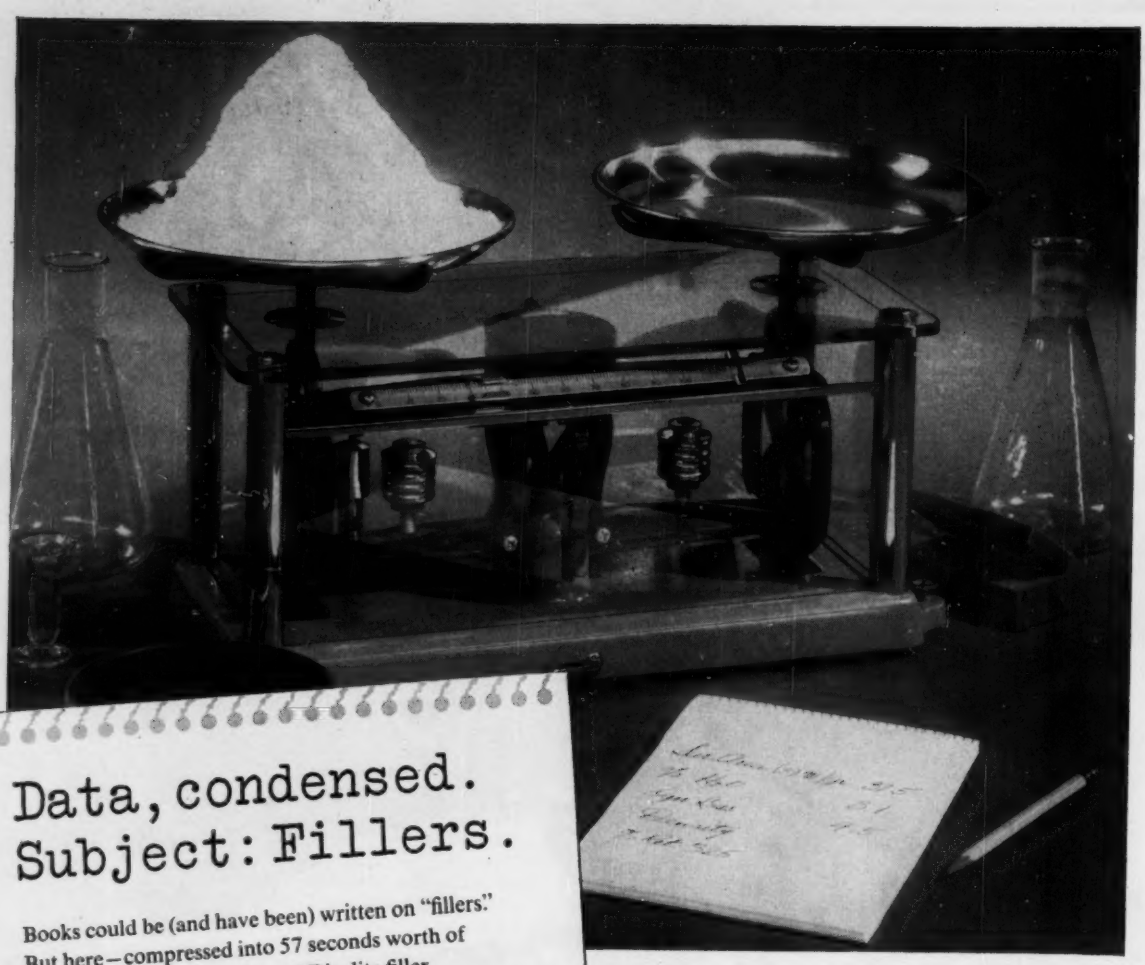
Pittsburgh Corning Corporation

Dept. H-95, One Gateway Center
Pittsburgh 22, Pennsylvania

In Canada: 57 Bloor St. W., Toronto, Ontario

Mississippi Chemical avoided a costly shutdown of this ammonia storage sphere by reinsulating it in sections. As each section of the old, watersoaked insulation was removed, it was immediately replaced by waterproof blocks of FOAMGLAS. Insulation Contractor was North Brothers, Birmingham, Alabama.





Data, condensed. Subject: Fillers.

Books could be (and have been) written on "fillers." But here—compressed into 57 seconds worth of time—are the salient points of Dicalite filler materials, quick and easy to review for possible application in your own projects.

Dicalite fillers are processed from diatomite into uniform, finely divided amorphous powders, practically pure SiO_2.

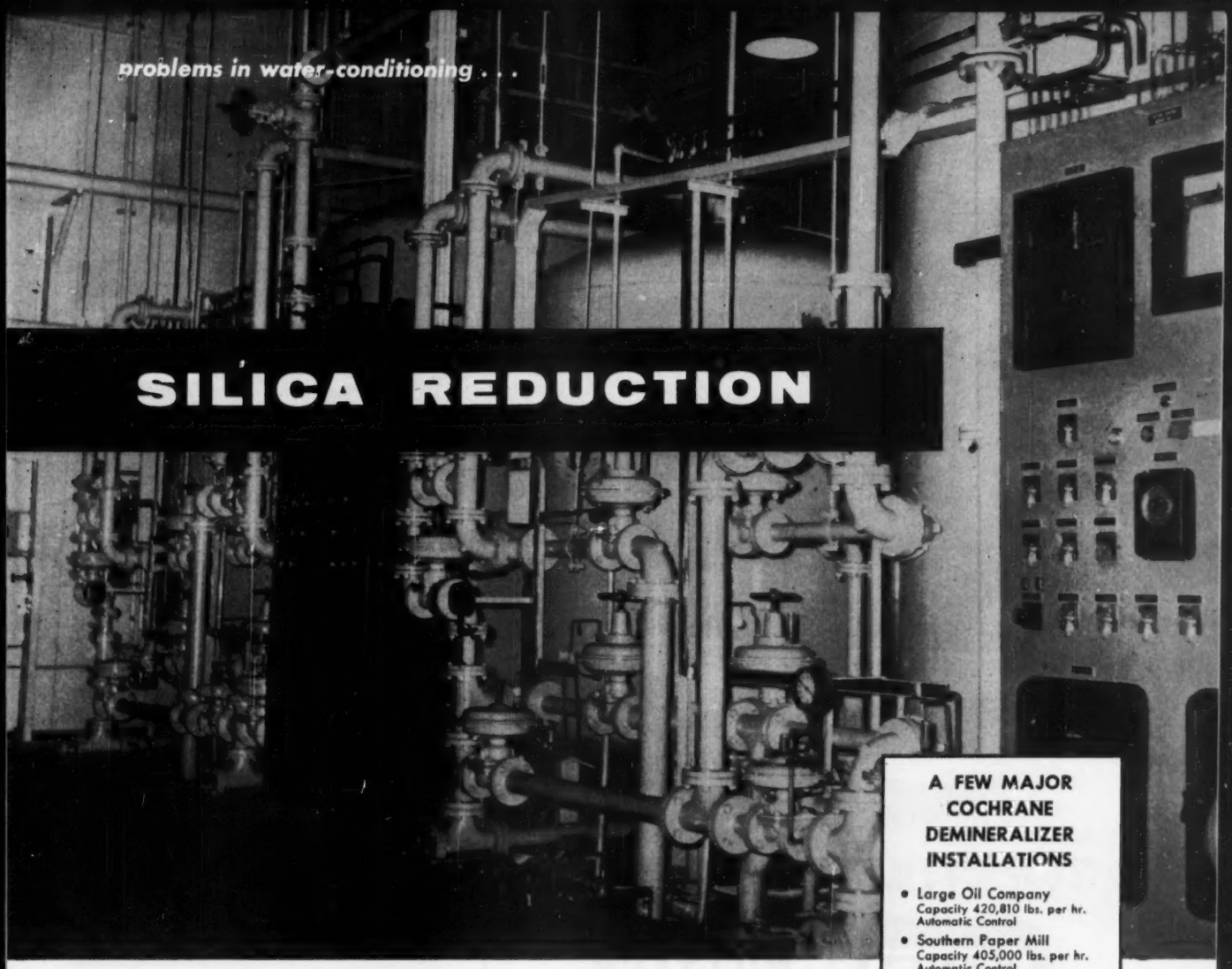
MELTING POINT. 2900°F, approx.
MOISTURE. From 0.1 to 6%, depending on grade.
IGNITION LOSS. 0.1 to 5%, approx.
PARTICLE SIZE. Grades varying in fineness up to trace retained on 325 mesh screen. Coarser available.
POROSITY. 70 to 95%.
SURFACE AREA. 7,000 to 150,000 sq. ft./lb.
DENSITY. 7 to 13 lb./cu. ft., loose weight. Apparent specific gravity, 0.112 to 0.21; actual specific gravity, 2.00 to 2.35.
ABSORPTIVENESS. 120 to 300% of weight of Dicalite.
WETABILITY. Excellent.
INERTNESS. Essentially inert in aqueous and acid solutions.

Dicalite fillers supply bulk without significant weight increase and give added strength and toughness. They also improve flexibility, reduce brittleness, decrease heat conductivity, and improve abrasion resistance. In certain products, appropriate Dicalite materials provide excellent mild polishing qualities.

We will be glad to advise on the most suitable Dicalite grade for your purpose, or to work with you in developing a custom-made filler for your particular needs. Write us.

Dependable GLC GREAT LAKES **Dicalite**® DIATOMACEOUS MATERIALS

DICALITE DIVISION, GREAT LAKES CARBON CORPORATION, 612 SOUTH FLOWER ST., LOS ANGELES 17, CALIFORNIA



A FEW MAJOR COCHRANE DEMINERALIZER INSTALLATIONS

- **Large Oil Company**
  Capacity 420,810 lbs. per hr.
  Automatic Control
- **Southern Paper Mill**
  Capacity 405,000 lbs. per hr.
  Automatic Control
- **Textile Manufacturer**
  Capacity 360,000 lbs. per hr.
  Automatic Control
- **Utility**
  Capacity 266,400 lbs. per hr.
  Automatic Control
- **Aluminum Producer**
  Capacity 387,000 lbs. per hr.
  Automatic Control
- **U.S. Government**
  Capacity 298,800 lbs. per hr.
  Automatic Control
- **Automobile Manufacturer**
  Capacity 182,268 lbs. per hr.
  Automatic Control
- **Pharmaceutical Company**
  Capacity 29,880 lbs. per hr.
  Automatic Control
- **Chemical Manufacturer**
  Capacity 15,000 lbs. per hr.
  Manual Control
- **Steamship Installation**
  Capacity 1,776 lbs. per hr.
  Manual Control

For your protection
buy **Cochrane's** *experience*
in demineralization

An impressive list of Cochrane 2-bed, 3-bed, 4-bed and mixed bed Demineralizer installations have been providing continuous protection for years in many outstanding high pressure power plants in public utility and industrial fields.

The illustration above is just one of many such installations. Designed for a large paper company, it produces an effluent with a silica content of as low as 0.02 ppm and total dissolved solids of as low as 0.4 ppm. Cation units are 6′ x 6′ and anion units 6′ x 8′ providing demineralized water supply of over 100,000 lbs. per hour for 1200 psi boilers.

Demineralized water quality is superlative. Cochrane's progress in solving the many problems associated with demineralization is the result of untiring research by their staff of chemists, engineers and research men. This background is your assurance of satisfactory operation. Why not take advantage of it? For the answer to your water conditioning problem . . . consult Cochrane first. Ask for Bulletin 5800-B.

COCHRANE CORPORATION · WATER AND HEAT ENGINEERS SINCE 1863 · PHILADELPHIA

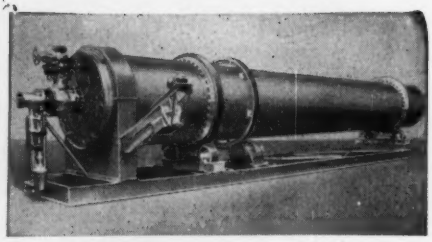
Cochrane
CORPORATION

Representatives in 30 principal cities in U.S.; Toronto, Canada; Paris, France; La Spezia, Italy; Mexico City, Mexico; Havana, Cuba; Caracas, Venezuela; San Juan, Puerto Rico; Honolulu, Hawaii.
Poltstown Metal Products Division—Custom built carbon steel and alloy products

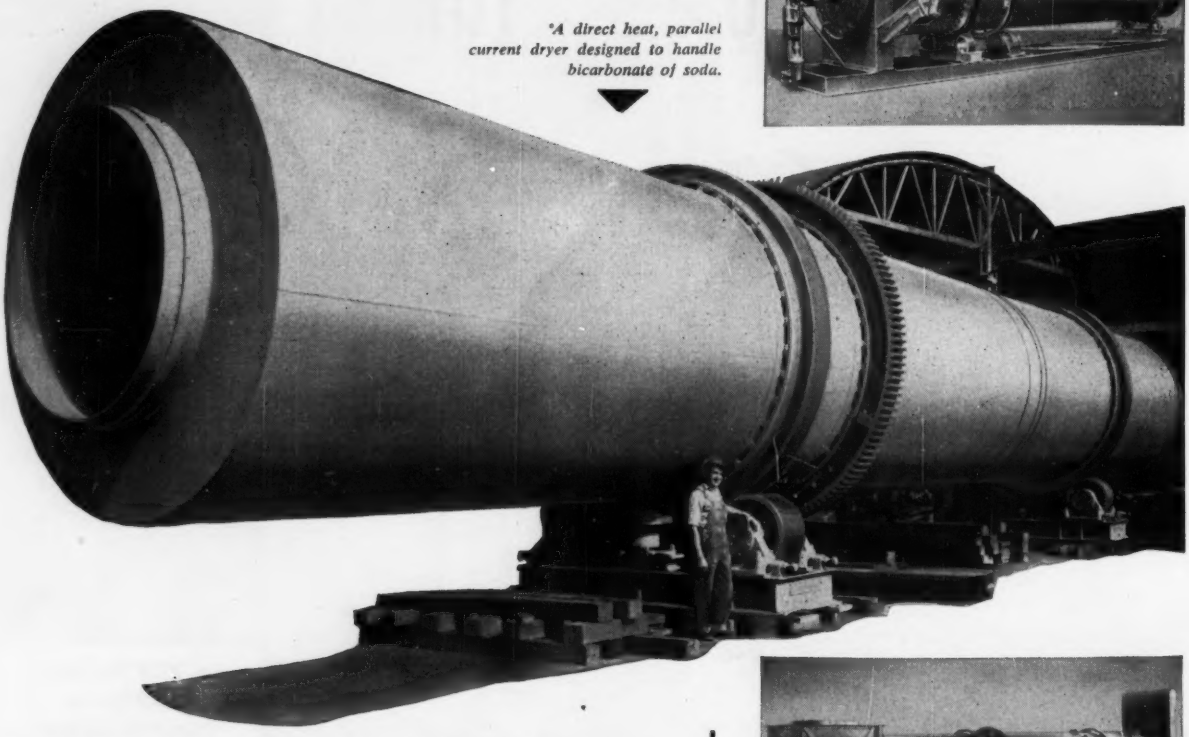
3113 N. 17TH STREET, PHILADELPHIA 32, PA.
NEW YORK • PHILADELPHIA • CHICAGO

Demineralizers • Hot Process Softeners • Hot Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Continuous Blowoff Systems • Condensate Return Systems • Specialties

Steam tube dryer. Enables continuous operation at uniform temperature, producing an extremely uniform product.



A direct heat, parallel current dryer designed to handle bicarbonate of soda.

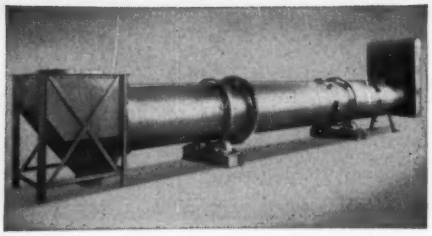


"LOW OPERATING COST" WITH

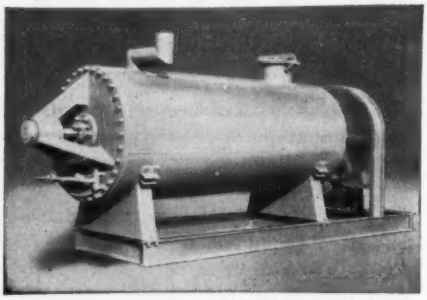
STANDARD HERSEY DRYERS

Presque Isle Starch Company of Maine reports potato starch drying production doubled... Huron Milling Company of Michigan reports one STANDARD-HERSEY dryer replaces 16 pairs of hot rolls... Stansbury Salt Company of Utah reports high efficiency at very low operating cost... Warriner Products Company of Louisiana reports *very satisfactory* operation in dehydrating sweet potatoes.

Hundreds of similar comments add up to one thing—STANDARD-HERSEY dryers are cutting costs and increasing production in many phases of the food field. We have, or can find, a solution to *your* drying problem. More than 30 different types of STANDARD-HERSEY dryers are available. Over 4,000 dryers have been built for hundreds of product applications. Investigate STANDARD-HERSEY for the answer to your drying problems.



Intermediate feed type starch dryer. Dries product from 40% to 18% with hourly output of 1,500 lbs. Extra high thermal efficiency because of no boiler loss.



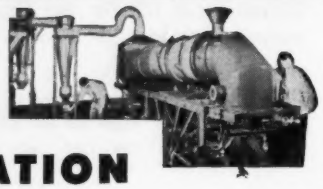
Steam jacketed batch type. May be used as either a dryer or cooker — operated under pressure or vacuum. Available with alloy or stainless interior.

SEND FOR FREE 12-PAGE ILLUSTRATED BULLETIN

Learn how STANDARD-HERSEY has aided manufacturers throughout the world in solving their dryer problems.

COMPLETE PILOT PLANT TAKES GUESSWORK OUT OF DRYING

STANDARD-HERSEY'S pilot dryers play an important part in solving your drying problems *before* blueprint stage.



THE STANDARD FOR 52 YEARS

STANDARD STEEL CORPORATION

5005 BOYLE AVE., LOS ANGELES 58 • 7 EAST 42ND ST., N. Y. 5

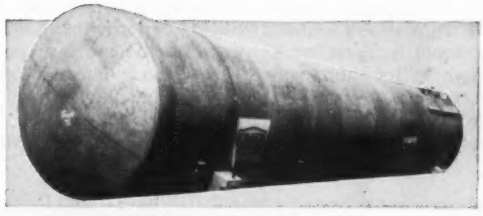
DF-2

Jets fly on jet fuel!

stored in GRAVER underground tanks

There was a time when Graver built tanks for storage of crude. That was 96 years ago when oil was first discovered. Graver still builds tanks for crude storage—and also for storing gasoline, kerosene, LP-gas and many other volatile liquids. Just recently Graver precision-fabricated a flock of large underground tanks for jet fuel storage. They will withstand a working pressure of 60 psi.

Whatever your storage problems, call on us. We have undoubtedly solved similar ones before.



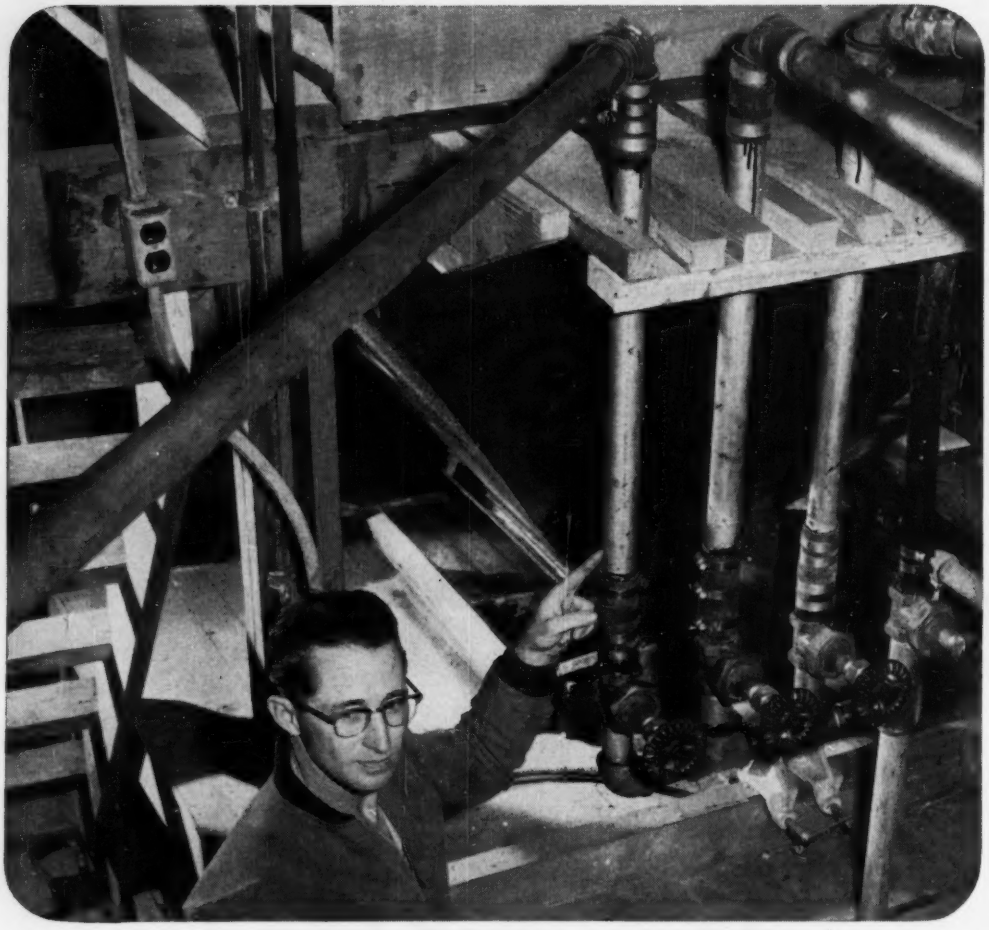
CLASSIFIED! Pictured is one of 35 tanks which will be buried in the ground at an undisclosed site. Each tank holds in excess of 50,000 gallons.

GRAVER® ... *BUILDING QUALITY TANKS FOR 98 YEARS*

GRAVER TANK & MFG. CO., INC.

East Chicago, Indiana

CHICAGO • NEW YORK • PHILADELPHIA • EDGE MOOR, DEL. • CATASAUQUA, PA. PITTSBURGH • CLEVELAND • DETROIT • TULSA • SAND SPRINGS, OKLA. • HOUSTON ODESSA, TEXAS • CASPER, WYO. • LOS ANGELES • FONTANA, CAL. SAN FRANCISCO



Carpenter Stainless Tubing cuts maintenance costs

Ends shutdowns for fertilizer plant!

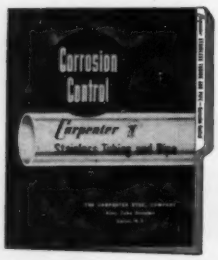
By switching to Carpenter Stainless Tubing and Pipe for handling strong acid and caustic solutions, both hot and cold, a liquid fertilizer company gained these cost-saving advantages in its entire network of process lines: Much longer service life . . . freedom from frequent shutdowns for replacements and resultant costly production losses . . . greatly reduced maintenance costs . . . easier-to-handle movable lines . . . increased plant operating efficiency.

Many other processing plants, too, have found that switching to Carpenter Stainless Tubing and Pipe pays off in lower production and maintenance costs, extended equipment life, greater freedom from costly down-time, and all-around satisfaction. Is corrosion control costing you too much with the kind of tubing and pipe you're now using? You'll get more than cost-saving corrosion resistance with Carpenter Stainless Tubing and Pipe. They have an industry-wide reputation for consistent quality and uniformity that mean trouble-free, time-saving fabrication and installation. Call in the nearest Carpenter Distributor or Representative for a profitable discussion of your problems and requirements.

MEMBER

The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

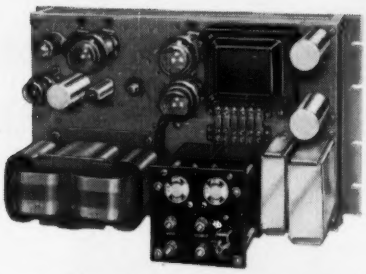
Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"



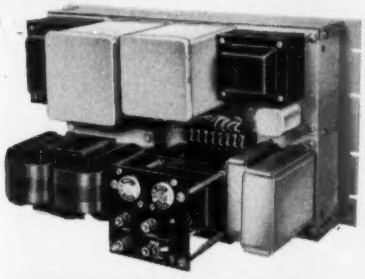
Here's a helpful guide for selecting and applying standard and special grades of stainless tubing and pipe for any corrosive condition. Ask for Bulletin T. D. 113.

Carpenter

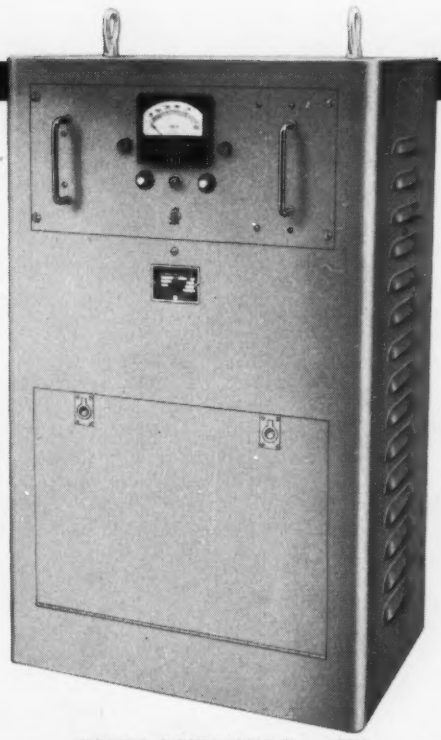
Stainless Tubing & Pipe



INSTANTANEOUS ELECTRONIC (type IE)
For instantaneous correction and extremely close control. Completely electronic. No moving parts.



TUBELESS MAGNETIC (type TM)
For unattended locations and critical uses where tube failure cannot be tolerated.



ELECTRO MECHANICAL (type EM)
For large industrial loads or for applications requiring zero waveform distortion and high efficiency.

STABILINE AUTOMATIC VOLTAGE REGULATORS

Designed to Maintain Root Mean Square Voltage

Here is a complete line of automatic voltage regulators designed with the application in mind . . . with *operating* characteristics that *always* equal or better the nameplate rating.

Of special importance is the fact that STABILINE maintains the root mean square voltage — the voltage rating for which all electrical equipment is designed. Before you purchase automatic voltage regulation equipment, make sure it is R.M.S. responsive.

We have detailed information about STABILINE automatic voltage regulators. Send the coupon for your copy of our Bulletin S351.

Be sure to see Superior Electric's Mobile Display when it is in your area.

THE SUPERIOR ELECTRIC COMPANY

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THE SUPERIOR ELECTRIC COMPANY
1409 Reynolds Avenue, Bristol, Conn.

Please send my copy of the STABILINE Bulletin

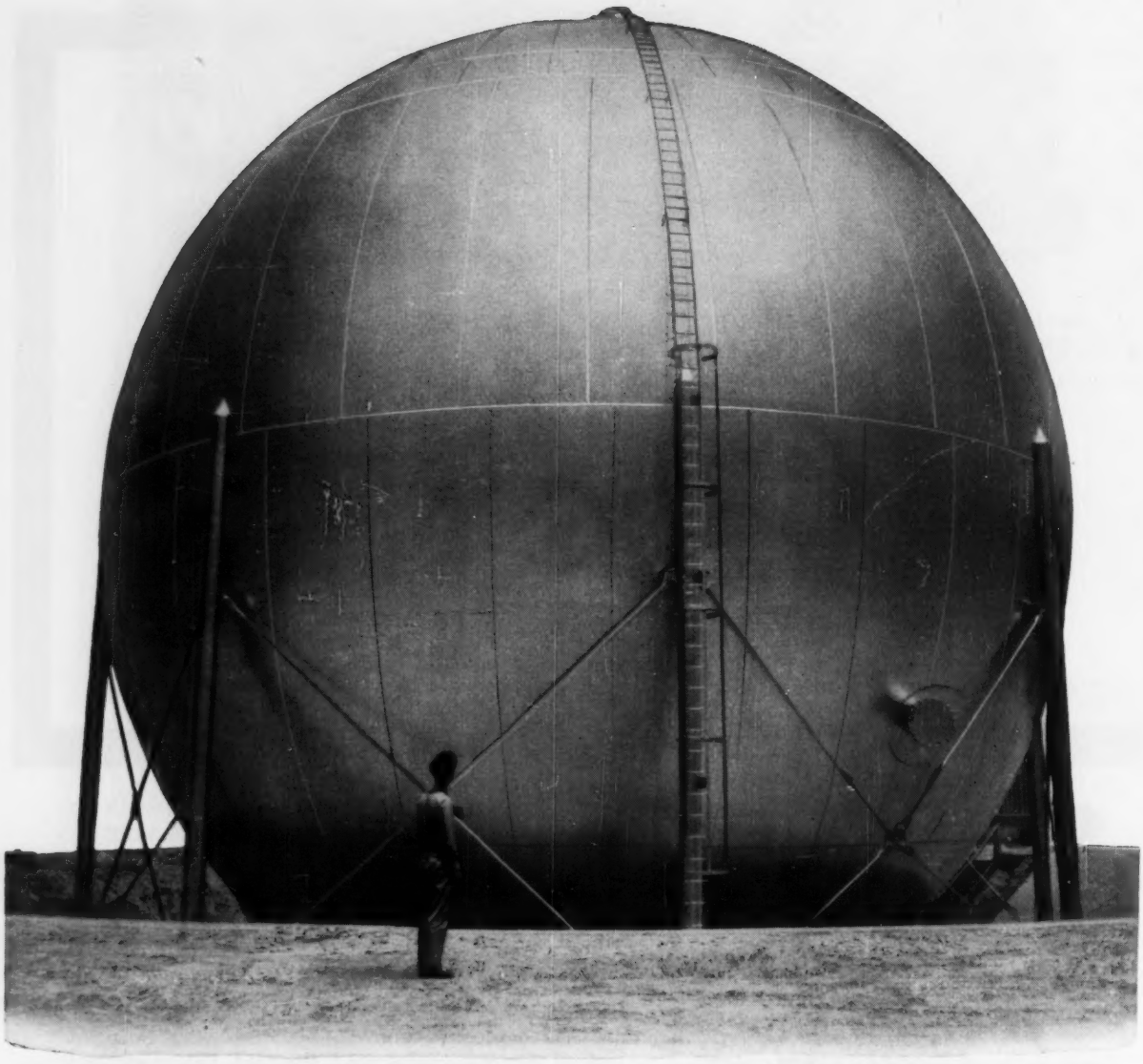
Name.....

Position.....

Company Name.....

Company Address.....

City.....*Zone*....*State*.....



PREPARING FOR THE ATOMIC AGE

The above true sphere, the largest of its kind in the U.S., is an important element in a vital research project.

Ask for Catalog 54B

HAMMOND IRON WORKS

WARREN and BRISTOL, PA. • PROVO, UTAH • CASPER, WYO. • BIRMINGHAM, ALA.

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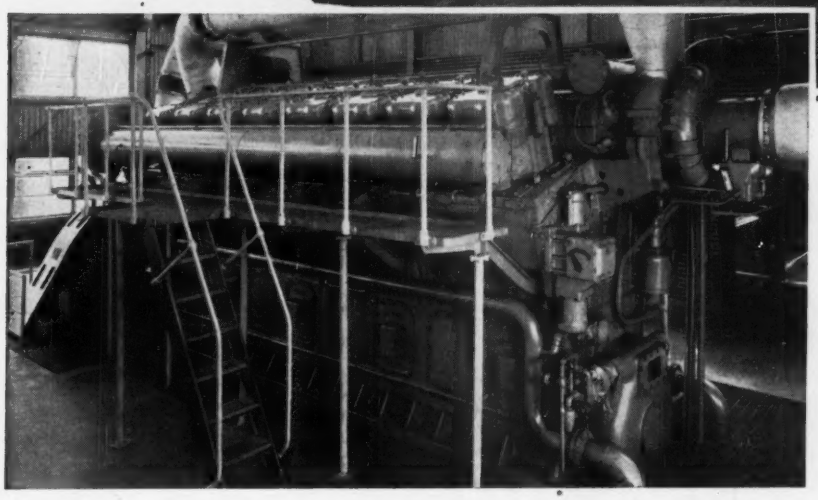
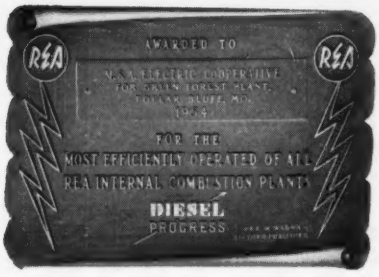
Cooper-Bessemer Flexibility Helps M & A Green Forest Plant Win "Top-Rated" Honors



Another Example of Efficient Power at Lower Cost

Here's one of the four Cooper-Bessemer LSV's that furnish dependable, low cost power in M & A's award winning Green Forest Plant.



• FOR THE FOURTH SUCCESSIVE YEAR the Diesel Progress annual award for the most efficiently operated REA internal combustion plant goes to a Cooper-Bessemer powered station . . . M & A Electric Power Cooperative's Green Forest Plant near Poplar Bluff, Missouri.

Here, four 16-cylinder Cooper-Bessemer LSV engines, each rated 3300 hp at 327 rpm, helped win the coveted bronze plaque by producing 58,945,000 kw. hours at a net cost of only 6.41 mills per kilowatt hour.

Even with varying combinations of fuel, and changing power load demands, these Cooper-Bessemer engines offer reliable performance and long-lasting economy. In part, this is done through automatic controls, utilized to quickly, economically convert from gas-diesel to oil-diesel in the event of low gas pressure, and back again to gas-diesel when normal pressure is restored.

Another feature of the M & A plant is the compact design of the Cooper-Bessemer V-type engines. *More* power can be concentrated per square foot of floor space for less extensive, less expensive engine foundations. For further information on heavy-duty Gas-Diesel, Diesel or Gas engines, contact the nearest Cooper-Bessemer office.

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Fabric helps Alcoa turn "Red Mud" into magic metal—

Aluminum at its versatile best—the Alcoa building in Pittsburgh.

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The process places heavy stress on the filtering fabric. The problem of developing a filter cloth that would stand up to strong caustics and provide easier "cake" discharge was given priority at Wellington Sears. We are proud that our specially developed fabric has been approved by Alcoa for commercial use.

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Brown high pressure heat exchanger sections are now performing, with high efficiency, in almost all the Petro-Chemical plants that have been built in the last five years.

BFT high pressure sectional heat exchangers are available for pressures up to 22,000 psi.

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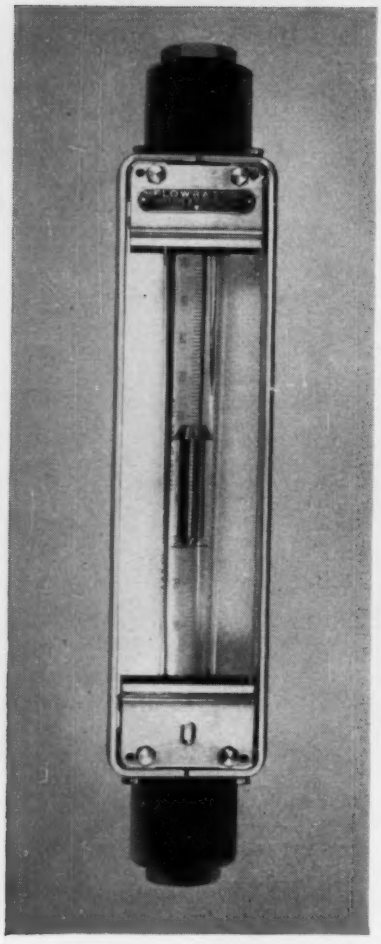
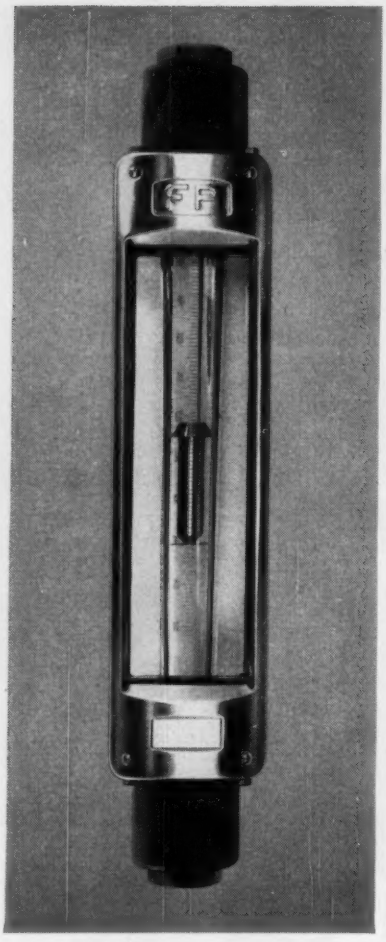
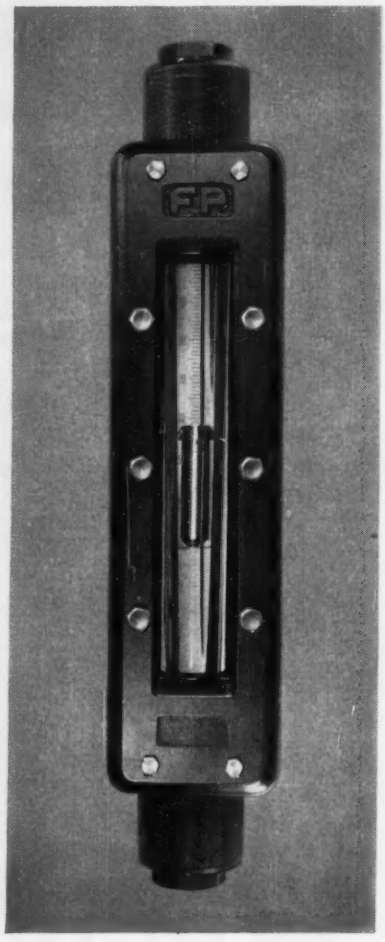


SIDE PLATE FLOWRATOR METER



ENCLOSED FLOWRATOR METER



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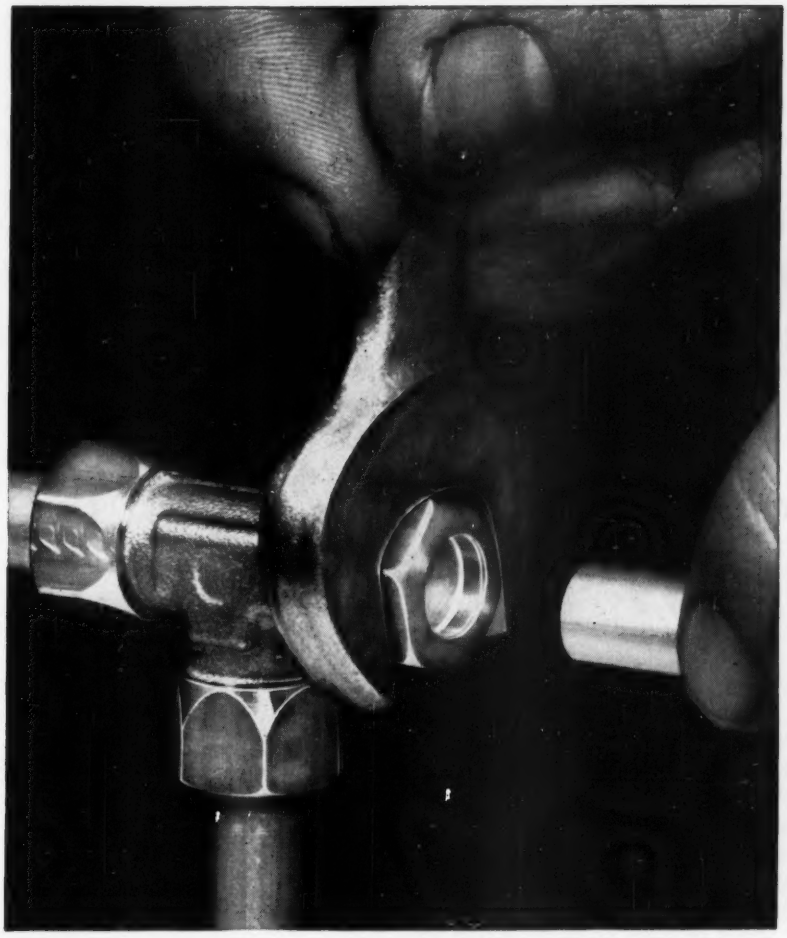

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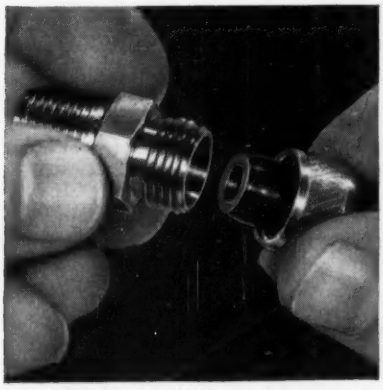

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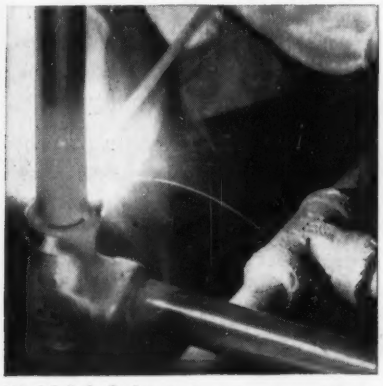

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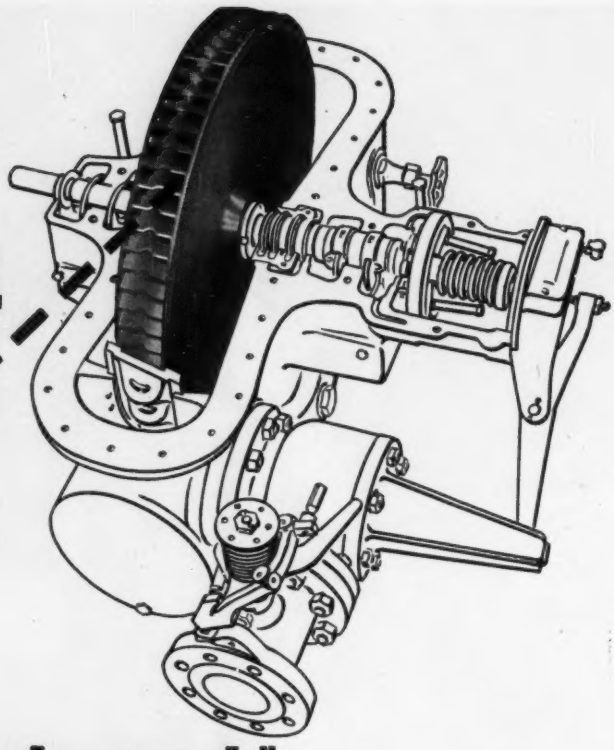

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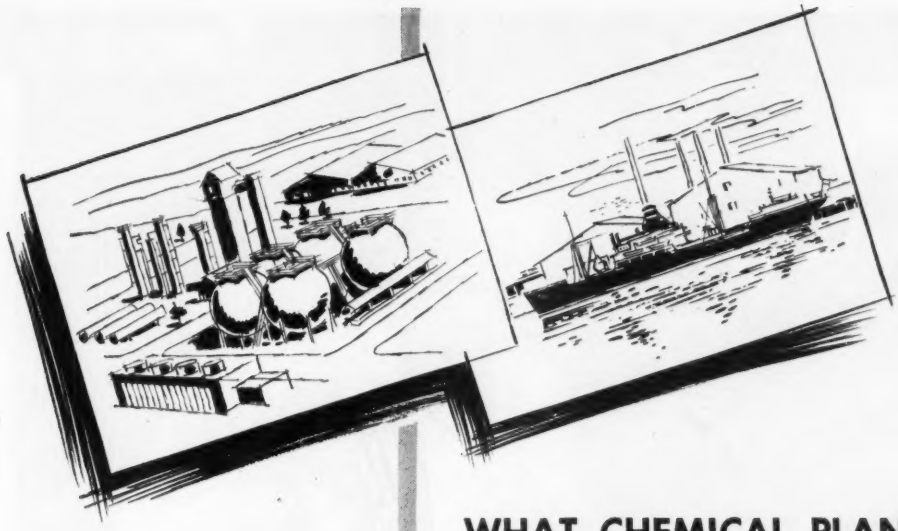

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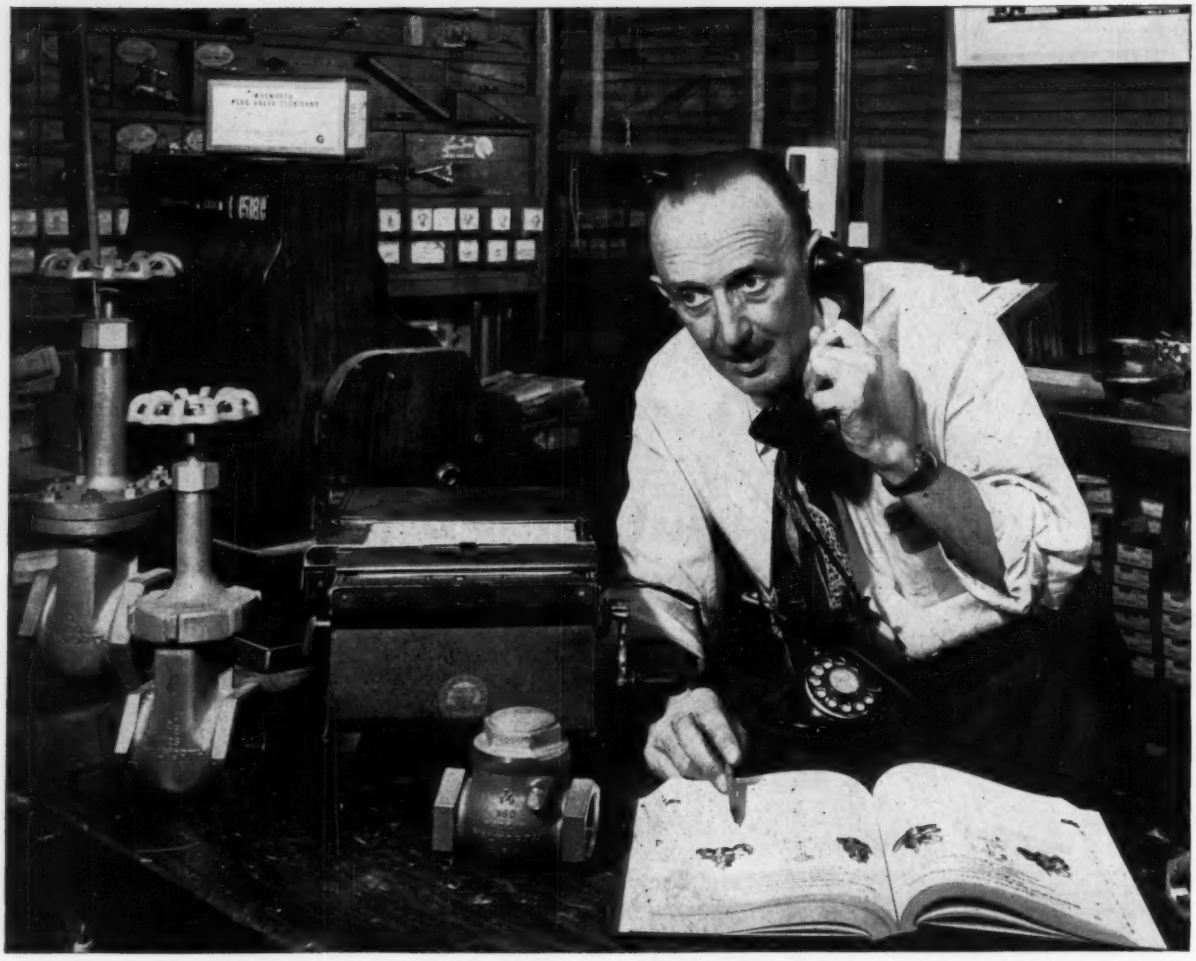

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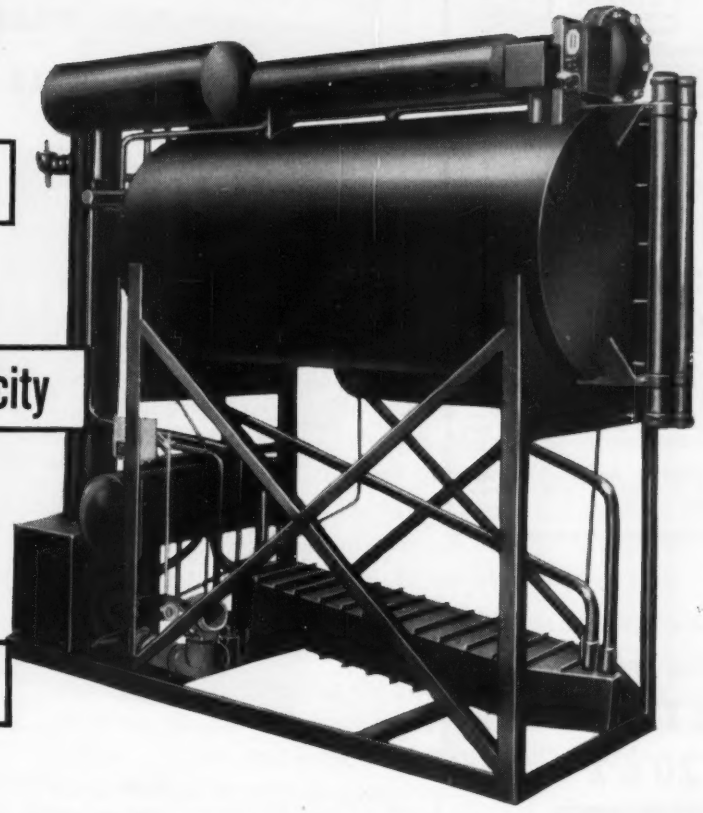

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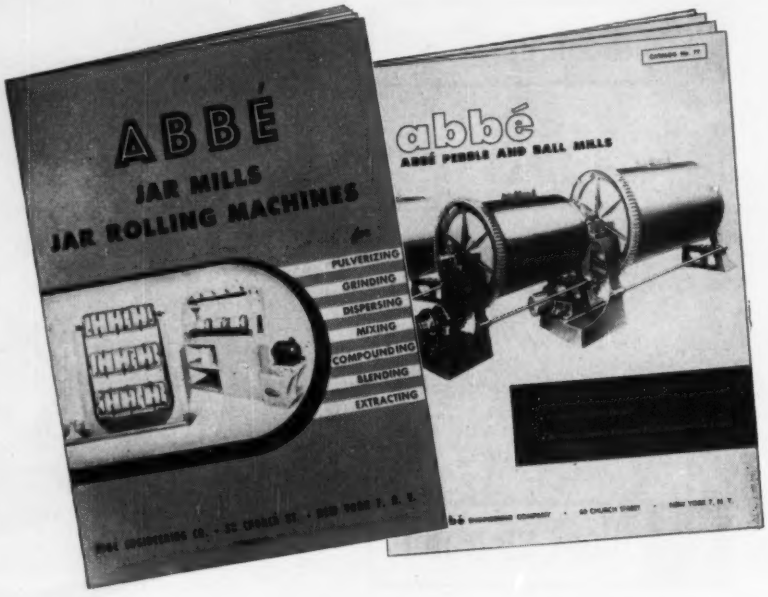

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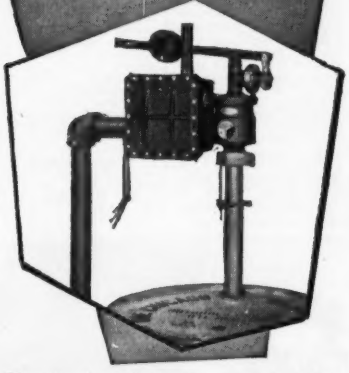

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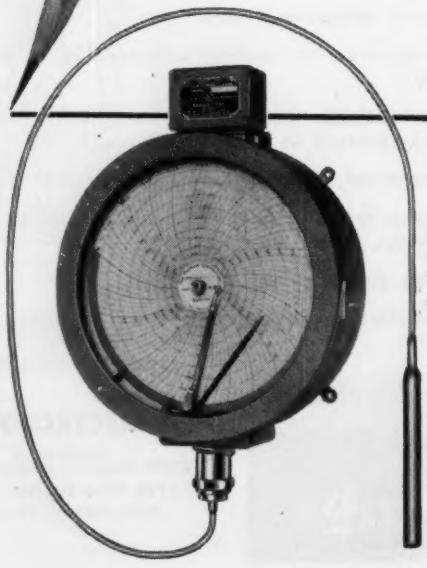

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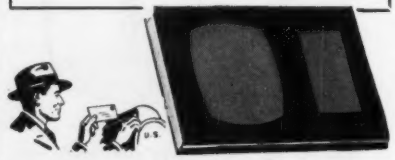

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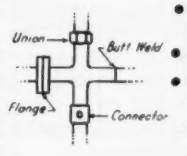

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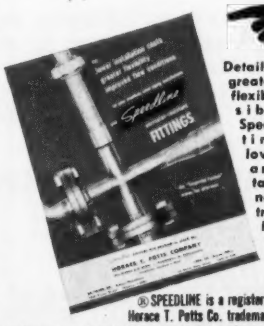

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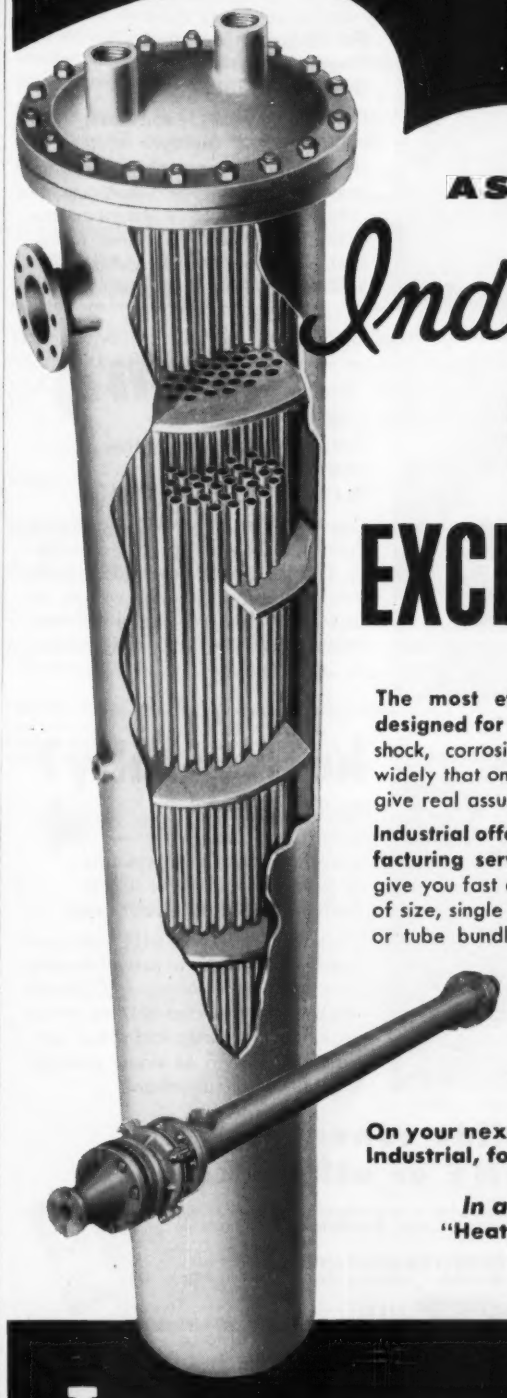

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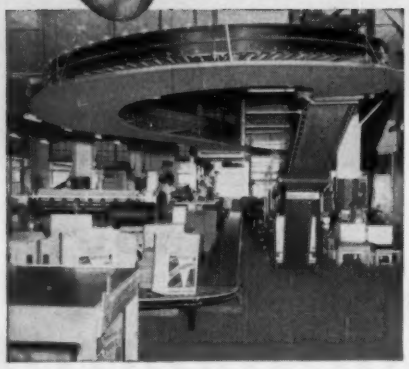

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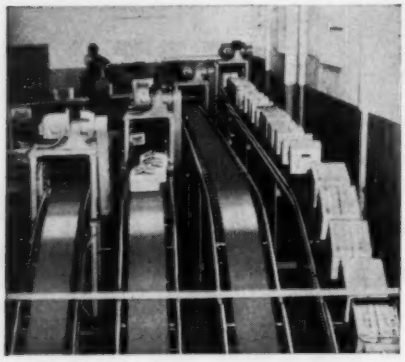
down



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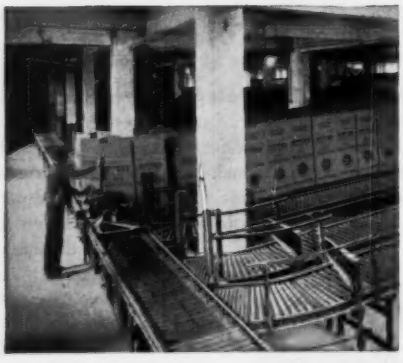

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Others went into greater detail—on content, arrangement of editorial sections, Reader Service—even the quality of the advertising. Comments and opinions were all over the lot. And they're still coming in.

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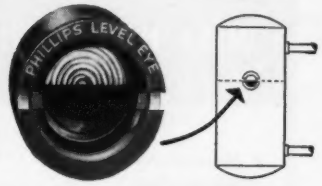
ANNUAL INVENTORY ISSUE

Chemical Engineering

ABP ABC

A McGraw-Hill Publication, 330 W. 42nd St., New York 36, N. Y.

PHILLIPS
Level Eye



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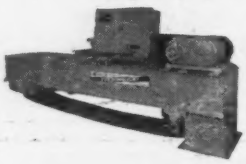

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Salaries commensurate with experience and level in organization. Advance on merit basis.

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P-7091, Chemical Engineering
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SW-7067, Chemical Engineering
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A large chemical company in the Detroit area has a challenging opportunity for a senior market research analyst. Necessary qualifications will include heavy experience in the field of market research as well as a college education in chemistry or chemical engineering. An excellent future and outstanding employee benefit plan accompany this position. Please submit a complete resume including salary requirements.

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CERAMIST or PHYSICAL CHEMIST

With strong interest in research involving high temperature solid state reactions between unusual ceramic materials, to participate in program to develop ceramic components for atomic energy uses. Advanced degree or experience desirable. To work in modern laboratories with excellent facilities.

Reply to Manager,
Salaried Personnel Administration,

The Carborundum Company
Niagara Falls, New York

WANTED TECHNICAL EDITORS

To provide for its continued growth Chemical Week is seeking two additional assistant editors — preferably chemists or chemical engineers with two to three years business experience. Essential: Ability to meet people, dig out facts, interpret them intelligently and write lucidly. Please submit resume to:

PERSONNEL DIRECTOR
McGRAW-HILL PUBLISHING CO.
330 W. 42ND ST.
NEW YORK 36, N. Y.

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(Graduated within last 10 years)

- Permanent positions in Mechanical Research and Development, Process Equipment Design and Application, Heat and Power Equipment Design, Construction Management and other Engineering Fields.
- Salaries commensurate with education and industrial experience.
- Opportunities to grow with a leading chemical processing company —rated as one of the nation's three best-managed companies by the American Institute of Management.

For application form and further information write

Mr. T. M. Turner
Head of Employment
Engineering Division
Procter & Gamble
Cincinnati 17, Ohio

Wanted
CHEMICAL ENGINEER:

For process development and production work. Two to five years' experience preferred. Modern expanding chemical manufacturing plant in West Virginia's Ohio River Valley section. Engineering now in progress for several new products. Modern research and development facilities now being constructed. Excellent opportunities.

P-7349, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

CHEMICAL ENGINEERS

Central engineering division of large manufacturer of diversified industrial chemicals has positions available for chemical engineers with 1 to 3 years' experience. Excellent opportunities for growth in an expanding organization. Work consists of process development, pilot plant operation, plant design, construction follow-up and commercial plant start up. Central New York State location. Submit complete resume and salary request.

P-7276, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

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(Classified Advertising)

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RESEARCH ENGINEER

Steel Division of Ford Motor Company

Doctorate or Master's Degree with research experience in metallurgy and/or chemistry required. Applicant must be capable of originating, designing and directing experiments in metallurgical process development.

Send resume of education and work experience, including present salary to:

Salaried Personnel & Training Section
Industrial Relations Department
Steel Division—Box 538
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BUSINESS OPPORTUNITY

Pure Kel-F or fluorothene laminate sold below present cost of film or sheet alone. Maximum about 42"x54". Also, embedments, circuit tracks one or more layers. Sheet thickness accurately variable if desired. Armen Incorporated, 8-22 Astoria Boulevard, Long Island City 2. N. Y. YEllowstone 2-4016.

AVAILABLE
WANTED

CUSTOM REFINING FACILITIES . . .

- Complete Distillation Service • Distillations
- Extractions • Fractionations Drum Lots—Tank Cars
- All Types of Crude Mixtures
- By-Products, Residues, Wastes
- Contaminated Solvents

Trufland CHEMICAL & ENGINEERING CO., Inc.
Box 426, Union, N. J. Murdock 6-5252

SAVINGS IN NEW AND USED
PROCESS EQUIPMENT

For Laboratory and Production

HIGH SPEED STONE MILLS
PEBBLE MILLS; Large Selection

COLLOID AND ROLLER MILLS, AGITATORS MIXERS, CRUSHERS, FILTERS, STRAINERS CENTRIFUGES, PUMPS, TANKS, KETTLES HOISTS, EX. PR. LIGHTS AND GENERAL PAINT FACTORY SUPPLIES OF ALL TYPES

SPOT LOTS OF RAW MATERIALS
TO BUY OR SELL— *TRY*

GENERAL TRADERS, Inc.
2627 Grand Ave. Chicago 12, Ill.
PH: ARmitage 6-8050

FOR SALE

New, unused 940 gallon Monel Sulfonator 62" x 72" with bolted-on head with 147' 1½" Schedule 40 Monel Pipe Coil with 4" bottom outlet. Mixing Equipment Co. Agitator Drive Model 116-TEC-51. 5 H.P. Exp. P. Motor. $5000.00 F.O.B. Shipping Point.

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P. O. Box 1818 Greenville, South Carolina

PLASTICS CHEMIST

Chemical Engineer with leadership ability required for challenging opportunity in expanding development program of solid, energetic organization. Experience in plastics compounding and processing required. Knowledge of vinyl sheeting, stabilizers, plasticizers and various resins essential. Economics and business administration training of interest. Write with full particulars on personal data, education, experience and salary requirements to

P-7415, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

WE NEED

All Kinds of Oil Refinery and Chemical Equipment, also Tanks

Write — Wire — Phone
Weinstein Co., Div. of Surplus & Salvage Co., Inc.
610 West 8th Street Jamestown, New York

Liquid Chemical Barges
FOR CHARTER

We will have barges constructed for your special requirements which you may charter at reasonable rates.

NATIONAL BARGE COMPANY
316 Fourth Ave., Pittsburgh 22, Penna.
Member: American Waterways Operators Assn.

WANTED—SURPLUS

Chemicals—Dyes—Drugs
Colors—Pigments—Oils—Waxes
By-Products—Wastes—Equipment

CHEMICAL SERVICE CORP.
80-04 Beaver St. New York 5, NY

WANTED

TANKS — KETTLES

Stainless Steel Tanks 300 to 1000 gal.
500 and 750 gal. Water Jacketed Tanks
300 and 500 gal. S/S Jacketed Kettles
good for 125 lb. pressure
Give full description and location!

W-7307, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

MODERN REBUILT EQUIPMENT

At Bargain Prices - Immediate Deliveries

UNION Rebuilt Machinery Established 1912

MIXERS

850 gal. Jacketed Mixing Tanks.
Day 35 to 75 gal. S. J. Imperial Double Arm Mixers.
Day 650 gal. Jumbo S. J. Mixer.
Koven 2000 gal. Spiral Jacketed Mixer.
Stokes, Day, New Era, Hottman Mixers, from 2 to 450 gal., with and without Jackets, Single, Double Arm Agitators.
Baker Perkins, Day, Readco Heavy Duty, 2 to 160 gals., Double Arm Jacketed Mixers with Sigma or Fish Tail Blades.
Gemco 56 cu. ft. Double Cone Blender.
J. H. Day 50 gal. Imperial S.S. Jacketed Double Arm Mixer.
Day, Robinson, Bailey, 15 to 10,000 lbs., Dry Powder Mixers.

LABELERS

Resina LC, Capem, Elgin Cappers.
Burt Wraparound Labeler, to gal.
Pony M, MX, ML, World, Ermold, Pneumatic Semi and Automatic Labelers.

FILLERS

Horix and Elgin Rotary Fillers.
S. & S. G1, G2, G6, HG88 Fillers.
MRM S.A. Stainless Steel Vacuum Fillers.
Carter B1 Vacuum Powder Filler.
Triangle Elec-Tri-Pak Fillers, all sizes.
Elgin 5-Head, Hope 1, Filler 4-Head Stainless Steel Piston Fillers.

PACKAGING MACHINES

ABC Automatic Carton Sealer.
Standard Knapp 429 Carton Sealers.
Pneumatic Scale Cartoning Line.
Miller, Hayssen, Package Machinery, Oliver, Campbell, Transwrap Wrappers.

TABLET MACHINES

Colton 2, 3 RP Rotary Tablet Machines.
Colton #5½ Punch Tablet Machines.

GRINDING MILLS—SIFTERS

Mikro 4TH, 3TH, 2TH, 1SH and Bantam Pulverizers: Schutz O'Neill Mills.
Charlotte #3 Monel Colloid Mill.
Eppenbach V9 Aloxite Colloid Mill.
Rotex, Day, Robinson, Tyler Hum-mer, Great Western, Gayco, Raymond Sifters.

MISCELLANEOUS

Podbelniak 6080 S. S. Solvent Extractor.
Oliver, Sweetland #2, Sparkler, Sperry, Shriver, Alsop Filters.

Immediate Deliveries

OVER 5,000 MACHINES IN STOCK—INSPECTION INVITED
Complete Details and Quotations Available—Write Today!

UNION STANDARD EQUIPMENT CO.
318-322 Lafayette Street New York 12, N. Y.

FOR SALE--

R.R. EQUIPMENT

Immediate Delivery

- **REPAIRED**
- **REBUILT**
- **or "AS IS"**

Hopper Cars - Tank Cars
Flat Cars - Gondola Cars
50 and 70 ton Capacities
Tank Car Storage Tanks
Locomotives and Locomotive Cranes

Tank Cars repaired - Major or Minor - and LITHCOTE lined, in our modern and well-equipped plant at Landisville (Lancaster Co.), Pa.

RAIL & INDUSTRIAL EQUIPMENT CO., Inc.

30 Church Street NEW YORK 7, N. Y.
RR Yard & Shops LANDISVILLE, PA

NEW AND GOOD-AS-NEW EQUIPMENT

1—Brewer Ampul Washer. Stainless Steel, 7000 ampuls per hour, 6-box type.
1—Stainless Tank #430-Chrome, vert. 7'x10' deep.
20—Jacketed Kettles—Stainless, Copper, Aluminum.
1—Day Mixer, steam jacketed, 50 gal. Sigma Blade.
1—Copper Evaporator, steam jacketed, 9'1"x3'9".
60—New Pressure Cookers, 18"x18" & 24"x28".
150—Pumps—steam and electric.
1—New Glass Nash Centrifugal Pump, 160 gpm.
1—Buflovak Jacketed Impregnating Tank 42"x52".
1—4x8 Sturtevant Jaw Crusher.
1—Ribbon type Mixer, steam jacketed.
1—Abbe Ball Mill, 36"x42" Buhrstone lined.
#316 Stainless Steel Tanks, new 100, 200 & 360 gal.
1—Nash Air Compressor, Type AL-623.
1—Manton Gaulin Stainless Homogenizer, 125 gph.
1—I&R Vacuum Pump, 5 H.P., 60".
4—Heat Exchangers, 12" dia. 11' lg., 43 steel tubes.
1—Stokes Single Punch Tablet Machine.
1—Kennedy-Van Saun Rotary Dryer, 4'x40'.
Davenport Rotary Steam Tube Dryer, 6'x36'.
2—Stainless Steel Steam Jacketed Readco Mixers.
1—#316 Stainless Reactor, 265 gals. cap., jacketed.
Abbe Pebble & Tube Mill, 5'x22'—Buhrstone Lined.
1—Patterson Ball Mill, porcelain lined, 17"x27".
1—Patterson Ball Mill, 42x36, jacketed.
3—Dopp Kettles with agitators, 600 gal. cap.
45—Steel Tanks from 100 to 100,000 gals.
2—Large Steam Jacketed Horizontal Mixers.
Robinson Pulverizer #20, with 2 motors, 10 HP each.
Robinson Ribbon Type Mixer, 30"x10'—like new.
4—Horizontal Retorts 200# w.p., A.S.M.E., from 12" to 24" dia., 4' to 12' long.
2—Crystallizers—10' long.
1—Patterson Kelly Blender 5 cu. ft. Stainless Steel, with baffle plates and 1 H.P. motor & 1—10 cu. ft. with 2 H.P. motor.
3—3,000 gal. Jacketed Kettles with Turbo Agitators.
1—#10 J. H. Day 300 gal. Sigma Blade Mixer, Jacketed.

H. LOEB & SON :-: 4643 LANCASTER AVE., PHILADELPHIA 31, PA.

CRUSHERS, ROLL—24x18, 30x16, 32x12, 42x16 and McLanahan single roll 24x36
CRUSHERS, JAW—6x9 New Holland, 11x26 Champion, 24x13 Farrel Bacon 22x50 Champion
HARDINGE MILL—2x8, 6x22, 7x22, 10x48 air swept
FEEDERS—Syntron F-44 (Celenium Rect), Mecco 42" disc Hardinge Style B
SCREENS—Tyler Hummer 3x5, 4x5, Cedar Rapids 4x10 double
AUTOCLAVES—s/s—1 gallon—1000 psi—jacketed agitated
PEBBLE MILLS—14 gal. jar—4x5, 6x4 porcelain lined
BLOWERS—Spencer Turbo 1300 cfm—16 oz.—Sturtevant Size 115—Design 7
STILL—54" dia. x 10 high with coper condensors and vacuum pump
CLASSIFIER—Rake—Rubber lined—Dorr 2'x40'—3 comportment.
COMPRESSORS—194 cfm with 40 HP motor—Gardner Denver
NASH VACUUM PUMPS—MD 673, AL 673, MD 623, 1253 and H 7

LAWLER COMPANY
Durham Avenue Metuchen, N. J.
Metuchen 6-0245

COMPRESSOR DIRECTORY

World's Best Rebuilts

All Makes
Many Sizes
Electric
Steam
Gas
Diesel
AIR
Air for Sale or Rent
Since 1902
1 CFM to 5700 CFM
1 lb. to 3500 lbs.

American
AIR COMPRESSOR CORP
NORTH BERGEN, N. J.
Telephone UNion 5-4848

LIQUIDATING
FROM CLOSED PLANTS

SPECIAL OFFER

Quadruple Effect Evaporator—total 6775 sq. ft., Vertical long Copper tubes. Built 1946 by Goslin-Birmingham.

1—Traylor Rotary Kiln 10'6" dia. 105' long, welded shell ¾"

1—Rotary Kiln 6' x 50'

2—Rotary Dryer 4'6" x 40'; 3' x 24'

1—Penn, Ring Type Granulator, Trojan K3-24, 40 HP

1—Allis Chalmers 6' dia. x 16' long steel lined continuous Ball Mill

3—Patterson & Abbe 4'6" dia. x 12' long Continuous Pebble Mills

1—Charlotte Colloid Mill, model #50, 75 HP motor

1—Fletcher 40" Perf. Basket Susp. Centrifugal, steel

2—AT & M Weston 40" centrifugals steel

1—Sweetland #5 filter, 20 lvs.

1—Bird solid bowl Centrifuge 36" x 50"

1—Bird 24" Horiz. Centrifuge CH-208

3—Muffle Furnace chrome nickle alloy tubes 24" x 8'6" long

3—Rotoclone Type W, size 20, Exhausters and Dust Collectors

1—Nash H-4 Hytor Compressor with 20 HP motor, Bronze

1—Worthington type HS steam driven gas Compressor, size 7 x 16 x 9, cap. 542 CFM deld. @ 15# pr.

1—Coppus 75 HP Turbine Drive

2—Coffin 68 HP Turbine Driven Centrifugal Pumps.

1—Type 316 Stainless Steel Tank, 5/16" thick dished heads, heat treated and water quenched:
4200 gal. 6' dia. x 20' long

1—Trough Belt Conveyor 15" W x 125' L

1—Trough Belt Conveyor 18" W x 85' L

1—Pan Conveyor, 24" W x 150' L

1—Pan Conveyor, 12" W x 85' L

1—Skip Hoist, 43' lift 4800# cap.

2—Shepard-Niles 4 ton Monorail Cranes w/motor, cab controlled

IN STOCK

2—Blaw Knox ½ gal. St. St. Autoclaves, 2000# pr., Agit.

1—2000 gal. T347 St. St. Jktd. Vacum Tank

2—Fitzpatrick Comminuting Mach., D6&F

1—Conkey Triple Effect Evaporator, Herculoy, total, 1900 sq. ft. Unused.

1—500 gal. St. St. Evaporator, 145 sq. ft. heating coil.

8—Distillation, Solvent Recovery and Absorption Columns — 8" to 72" dia — Aluminum, Copper, Steel, Stainless Steel

1—Sharples 16P St. St. Centrifuge, pressure-tite. Used.

1—A.T.&M. 48" Susp. Centrifugal, Perf., St. St. Fume Tight

1—Stokes 3' dia x 15' L Jacketed Rotary Vacuum Dryer

1—8800 gal. vacuum or Pressure Cooker with agitator and Vacuum pump, ASME

4—Atm. Double Drum Dryers, 22" x 38", 24" x 60", 42" x 120"

5—Shriver 30' x 30" C.I. Filter Presses, open del 28 to 50ch.

1—Sperry 15" aluminum P & F Filter, 29 ch.

2—W & P 100 gal. Sigma Blade Jktd. Mixer

2—Pebble Mills 6' D x 8' L.

20—Aluminum Tanks — 500 to 3000 gal.

9—Copper Tanks, 1723 to 2800 gal.

30—Agitator Drives to 40 HP

HQ. FOR STAINLESS STEEL EQUIPMENT

USED EQUIPMENT IN STOCK

40—S.S. Storage Tanks from 30 gal. to 10,500 gal. sizes.
15—S.S. Pressure or Vacuum Tanks up to 4000 gal.
15—S.S. Shell & Tube and coil type Condensers and Heat Exchangers from 14 to 785 sq. ft.
40—S.S. Jktd. open top Kettles from 40 gal to 1300 gal.
4—S.S. Jktd. agit. closed Reaction Kettles, 100, 450, 500, 1300 gal. sizes.
7—S.S. Side Ent. Agitators 10 HP to 25 HP

CONVERTING OR CHANGING EXISTING EQUIPMENT—(Your own equipment or our stock)—Can be done in our own shops utilizing good used or surplus new materials.

FABRICATION—(IN OUR OWN SHOP)—Heliarc welding. Water-quenched stabilized welds. Large stock of type 304 and type 316 sheets and prefabricated tank sections and heads carried in stock assuring quick delivery of tanks.

Equipment Bought & Sold

Plants Liquidated

BOTTLING CANNING MACHINERY PERRY SUPPLIES PROCESSING

PERRY EQUIPMENT CORP.

Phone ST evenson 4-7210

Cable—PERI

1413 N. 6TH ST. PHILADELPHIA 22, PA.

HOT ITEMS

YOURS FOR THE ASKING*

1—Sharples Super-D-Hydrator C20, 20 HP XP motor, SS Constr.
Stoke T-4 & S-5 Tablet Presses
4—Paterson 4', 5' and 6' conical blenders, MD
2—Fit Comminuters style D 7½ HP XP motors
21—Aluminum Condensers or Heat Exchangers 400 & 600 sq. ft.
1—Sparkler 18" S/S Filter
4—Patterson 4' x 4' chrome manganese jacketed ball mills, 225. gals.
1—Morehouse speed line mill, 20 HP
1—36" Iron P & F Filter Press 30 chamber, closed del.
1—W & P 500 gal. Model R & E M Jacketed double arm mixer
2—7500# dry powder mixers, double ribbon type.
4—B & J & Cumberland Rotary cutters 2-60 H. P.
1—J. H. Day 40 gal. Pony Mixer
2—Ross 30 AB heavy duty post mixers, 135 gals.
Sperry 18" open del. filter presses 23 & 44 chambers
1—Hersey Dryer-Monel Metal 3' x 24'
3—Baeird Dryers 4' x 30'
1—Louisville SS 316-6' x 45' tubular dryer, aluminum tubes.
1—Pittsburgh Lectro Dryer size 25 BAC
1—Kelly 250 sq. ft. S/S Sulphur Filter
7—Day 10, 20, 50, 75 & 100 gal. Dble Arm Mixers
1—210 Worthington Refrig. Unit, Turbine Driven
7—Karbate heat exchangers, 20.6 sq. ft. & 70.6.

*Our new money back policy and/or rental purchase plan

2—Patterson 3' x 4', 100 gal. Porcelain pebble mill
1—Simpson #2 mixer, M.D.
2—1-40" link suspended SS centrifuge, 7½ HP motor.
5—48" x 120", 24" x 36", 32" x 52" DBLE drum dryers, one vacuum.
1—Devine SS 10 shelf vacuum shelf dryer, 23½" x 29".
4—12'6" Jeffrey bucket elevators.
1—Amer. Tool 40" copper, bottom disch., suspended centrifuge, MD
1—Buflovok monel single effect evaporator, 148 sq. ft.
1—Colton #5½ T single punch tablet machine
2—Sweetland #12 & 10 filter.
2—Pfaudler 500 gallon model ELL glass lined reactors, agitated
1—Feinc 5'3" x 3' monel vacuum filter.
3—Triple, DBLE & single effect Evap. one monel
1—Buflovak 40" x 48" single drum flaker.
2—Sperry, 50 chamber wood filter presses, HYP closing.

* Subject to Prior Sale

CURRENT LIQUIDATIONS

A. Chemical Vitamin A Plant, Ga
B. Pigment Plant, Delaware
C. Ore Smelting Plant, N. J.
D. Caustic Chlorine Plant, Kentucky

We purchase plants or individual pieces — What have you got for sale?

CHEMICAL & PROCESS MACHINERY CORP.

146 GRAND STREET
NEW YORK 13, N. Y.

WOrth 6-3430

FACTORY: 52 NINTH St.
BROOKLYN 15, N. Y.

PIECE MEAL LIQUIDATION

TOP NOTCH EQUIPMENT

From the Plant of Basic Protein Products, Inc., Moss Landing

Pfaudler 1000 Model "R" Glass lined Reactor
Buflovak Double Drum Dryer, 42" x 90"
4-Steel Vac. Pans, 8' dia 16'. Side Tube Heaters
S.S. Vacuum Pan 6' dia. x 12' straight side
Steel Vac. Pan 6' x 16'. Side Tube Heater
A T & M 48" Solid basket, Vapor-tite Cent.
2 Rotex Sifters, 40" x 84", single deck
S.S. Oblong Tank, 2500 gallon capacity
1000 Gal. S.S. Tank with ½ HP GHD Agitator
Wood Tanks, 1000-60,000 Gallons
Monel Pressure Tank, 1000 Gals, 40# ASME 650 Deg. F
Pfaudler Glass Lined Tanks, 250 to 6000 Gals
Sperry 36" iron rec. Filter, hydr. cl. 32 plates
Sperry 24" wood pl & fr Filter, 31 pl, & 30 frms.
Durichlor Cent. Pump, 3" x 2" with 10 HP motor
2 Bump Rotary Pumps, 4" S.S. with motors
Moyno 2" stainless steel Pump. (New)
Schutte-Koerting 3" rot. S.S. Pump with motor
3-Am. Hard Rubber 2" x 1½" Centrifuge Pumps with Mtrs
Bronze Cent. Pump 4" x 3" with 7½ Hp motor

PRICED TO SELL

5-Viking 2" Rot. Iron Pumps with motors
5-4" Yale & Towne Rot. Pumps with motors
Waterous 3" Br. Rot. Pump with motor
Aluminum Rotary Dryer 12" x 15' with fan & htr.
Misc. Motors ½ HP to 40 HP, some are gearhead
Ace Regulators, Elec. operated (6 avail).
Thermometers (12 available) Dial and Stem type
3 Sets Foxboro time Temp. Recorder-Cont.
3-Taylor Recording Controllers
4-Watt Meters & Ammeters, 200 Amps, 1000 KW
Misc. Special Fittings—Duriron 3" tank outlet, 3" Tees, 3" Elbows, 12-2" porc. Valves, 6-3" San. plug Valves, 5-4" Powell S.S. Globe Valves, 12-1¼" Globe high pressure S.S. Valves, Polyethylene Flanges, Elbows, Tees, and Adapters.
Ellis 30" S.S. Laundry type Perf. Basket Cent. with 3 HP Expl. proof motor
Rietz RD-18 Disintegrator with 50 HP motor
P & L Press with 7½ HP Speed-Trol drive, and pressure infeed with 5 HP gearhead drive.
Laboratory Equipment & Supplies—Microscope, Polarimeter, PH Meter, Refractometer, Colorimeter, Grinder, Vacuum Pumps, Centrifuges, Plate Heaters, Glassware and Chemicals

IMMEDIATE DELIVERY

MACHINERY AND EQUIPMENT COMPANY

514 Bryant Street • San Francisco 7, Calif.

★ FANS
★ BLOWERS
★ EXHAUSTERS

NEW and REBUILT

Save 30% to 50% on Stock Shipments

• We can supply all leading makes of—Rotary Positive Blowers . . . Turbo Blowers . . . Centrifugal Fans . . . Steel Plate Exhausters . . . *fully guaranteed*. Whether you need 1 cu. ft. of air or 100,000 we have the blower to do it. We have had 28 years of exclusive rebuilding experience on this type of equipment.

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STOP GO

. . . for BRILL Re-Nu-Bilt Equipment

See Additional Listings on Page 406

DRYERS

2—Cummer 5'x40', 5'x30' Rotary.
1—Vulcan 4½'x50' Rotary.
1—Link Belt 6'4"x24' steel Roto-Louvre, Dryer Heresite coated.
1—Link Belt 3'10"x12' steel Roto-Louvre Dryer.
1—Devine #27 double door Vacuum Shelf, 17—59"x78" shelves.
1—Stokes Vacuum Shelf Dryer #138-H-10 44'x40" shelves.
2—Struthers Wells 5'x15' nickel clad Rotary Vacuum.
1—Devine 5'x10' steel Rotating Vacuum.
2—Stokes 30"x8', 3'x15' Rotary Vacuum.
4—Buflovak Double Drum 32"x100", 36"x84", 32"x72", 32"x52".
2—Buflovak 6' and 3' dia. Crystallizers.

FILTERS

3—Oliver Monel 8'x10', 3'x2' Rotary.
2—Oliver 5'3"x6' Rotary Vac.
2—Sweetland #12—72, 36 leaves.
2—Sweetland #3 all S/S.
3—Sweetland #3, #5, #7.
1—Niagara 110 sq. ft. S/S.
1—Sparkler # 33-S-17, steel.
3—Shriver 36" P&F 42 chambers.
4—Shriver 30" P&F 30 chambers.
8—Sperry 24" P&F 16 chambers.
2—Sperry Aluminum 30" and 24" P&F.
1—Sperry 36" P&F, heresite.
12—Filter Press Skeletons, all sizes.

PULVERIZERS—CRUSHERS

1—Devine 5'x10' steel, jacketed Mill.
4—Hardinge Mills 4½x16", 5/x22", 5'x36", 6'x22", 10'x48".
4—Patterson 6'x8', 5'x6', 3'x4' brick-lined Pebble Mills.
1—Patterson 6'x8' porcelain (Berylite) Pebble Mill, 50 HP. NEW.
3—National 10"x20", 6"x12" Mills.
3—Gayco Air Separators 12', 8', 18".
3—Mikro Pulverizers #4TH, #2.

CENTRIFUGALS

1—AT&M 36" suspended 304 S/S.
1—Bird 40" Suspended, rubber.
3—Tolhurst 40", 32" Suspended, steel.
1—AT&M 36" rubber covered.
1—Fletcher 30" Suspended, steel.
1—Tolhurst 26" Suspended, steel.
1—Tolhurst 26" Suspended, rubber.
1—DeLaval AC-VO "Nozzle-matic" continuous 304 S/S.
2—Sharples PN Super-D-Canters, S/S.
2—Bird 18"x28" Continuous 310 S/S.
2—Sharples C-27, C-20 S/S Super-D-Hydrators.
2—Sharples #16P Monel and S/S. Super Centrifuges.

SPECIALS

2—Struthers Wells Reactors S/S or Converters 4½'x26' high, 7½'x40' high, S/S tubes 170 psi.
2—Struthers Wells Dowtherm units 2,000,000 & 3,000,-000 btu.
4—10'6x40' rubber lined Tanks 25,000 gal.
2—8'x16' Aluminum Tanks 6000 gal.
12—Heat Exchangers 150 to 650 sq. ft.
1—Blaw Knox 5'x26'8" Tank 400 psi.
8—Buflovak 7'x14' closed, jacketed steel Kettles, 50 psi with 10 HP Turbo Mixers 4000 gal. cap.
10—Steel Tanks 6000 to 15,000 gal.

SCREENS

4—#82 Rotex double deck 40"x120".
1—Patterson single deck 40"x84" S/S.
1—#23 Rotex three deck 20"x80".
3—Tyler Hummer, 4'x10', 4'x5'.

MIXERS

8—Day "Cincinnatus" double arm Sigma Blade, 660, 250 and 100 gals.
2—Baker Perkins 100, 50 gal. Sigma Blades, jacketed.
5—Sprout Waldron S/S. jacketed Powder Mixers, 67, 27 and 10 cu. ft.
1—Struther Wells 6'x9' S/S. jacketed.
2—Baker Perkins 2 gal. S/S.
1—Robinson 4000# steel powder.
6—Rodgers 400 to 3000# powder.
3—Simpson Intensive Mixers #0.
8—NEW Portable Agitators ¼ to 5 HP.
4—Day, Ross 8 and 50 gallon. Pony.

TOWERS—REACTORS—CONDENSERS & TANKS

1—2700 gal. 316 S/S. jacketed Reactor 5'x15', 316 S/S.
1—2800 gal. Tank 5'x18', 316 S/S.
1—Buflovak 800 gal. 347 S/S. clad, jacketed, agitated Reactor.
5—Towers: 7'x25'6, 347 S/S., 6'x63', 6'x58' chrome lined, 42"x49', 3'x53'.
4—Foster-Wheeler Karbate Heat Exchangers 188 sq. ft.
12—Heat Exchangers 50-2400 sq. ft. Admiralty & S/S.
5—Buflovak Condensers 20 to 90 sq. ft.
1—1400 gal. Aluminum Tank.

MISCELLANEOUS

10—Nash Vacuum Pumps TS12, H7, H6, L5, L3 MD571, #4, #2.
3—Stokes Vacuum Pumps 10 to 50 cfm.
14—Olivite, Duriron S/S Centrifugal Pumps 1" to 6".
10—Centrifugal Pumps 60 gpm to 2000 gpm, motor driven.
8—Stokes DD52, D3, & R Tablet Machines.

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Feeders: Syntron F-22, 10 x 36" trough.

Filters: Oliver 2½ x 1', Denver 1 x 3', Sparkler, Alsop, Lomax, Industrial.

Filter Presses: Sperry, Shriver 6" to 36", recessed and plate and frame types.

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5-roll high side Raymond complete.

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Dry Powder: Robinson copper body, 60 cu. ft. and 27 cu. ft.
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4—Buflovak Atmo. Dbl. Drum Dryers 24"x36", 32"x120", 42"x120".
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H. K. Porter 42" dia. Stainless Conical Blender.
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2—Read 50 & 100 gal. double arm mixers.
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3,000 gal. Glass Lined Tanks, Insul.
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3—#10BB Waukesha Pumps, 1 H.P.
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THE GELB GIRL SEPTEMBER 1955

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1—Nooter steel jacketed vacuum kettle, 750 gallons.
1—Plate Fabricators 6,000 gallon Jacketed Kettle.
12—Koven Stainless Steel Jacketed Vacuum Kettles, 380 Gals. Cap. Each.
1—Stainless Steel, 4000 gal. Tank.

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1—Bird Stainless Steel 48" suspended type Centrifuge with perforated basket, plow and explosion proof motor.
2—Sharples S.S. super pressurite centrifuges. Model 16.
2—Sharples Type 316 Stainless Steel Centrifuge, Model D2.
1—DeLaval Type 316 Stainless Steel Multi-Matic Centrifuge.
1—Elis, Stainless Steel, 30" centrifuge.
1—Fletcher S.S. Suspended Type Centrifuge, 40" Perforated Basket.
1—A. T. & M. Stainless Steel Susp. Centrifuges, 48" Imperforated Basket.

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5—Buflovak Single Door Vacuum Shelf Dryers 5, 7, 10 and 20 shelves.
1—Proctor & Schwartz Hot Air Dryer, 16 shelves.
1—Devine laboratory vacuum shelf dryer with 3 S.S. shelves (New).
1—3' x 12' Stainless Steel Rotary Vucuum dryer.
1—Steel and Alloy 3' x 15' Heresite-lined Rotary Vacuum Dryer.
1—Stokes Rotary Vacuum Dryer, 30" x 8'.
1—Buflovak 32' x 90" Double Drum Dryer.

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5—Stainless Steel Condensers, 15, 20, 55 and 90 sq. ft.
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1—Sperry 36" Plate and Frame Open delivery Filter Press, 40 ch.
12—Struthers Wells S.S. heat exchangers, 650 sq. ft. each.
1—Hatfield Stainless Steel Bubble Cap Column, 6' 16'6", 7 trays.

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1—Shriver, 36", 3 eye open delivery, washing type Filter Press with 35 chambers and Simplex hydraulic closing device.
1—Shriver C.I. Plate and Frame, 2 eye, open delivery Filter Press 42" x 42", 54 chambers.

1—Stokes Model "R" Tablet Press
6—Stokes Model "F" Tablet Presses
2—Stokes Model 43A Stainless Steel Granulators
1—J. H. Day Moto-Sifter 96" Discharge Height

1—Sperry 3-eye, closed delivery, cast iron. Plate and frame Filter Press, 9 ch., 30" x 30".
1—Sperry Wooden Plate and Frame Filter Press, 12" x 12", 15 chambers.

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1—Banbury Mixer, midget size with 2 HP motor.
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7 Hardinge Conical Ball Mills: 6'x14", 6'x22", 6'x36", 8'x18", 8'x22", 8'x36", 10'x48".
14 Hammermills: No. 2 Allis Chalmers, 20x24 Miller, 24x18 Cedar Rapids, 2033 Cedar Rapids, 5XA Gruendler, 36x24 Jeffrey Type B-2, 36x26 Universal, 36x48 Jeffrey, #4 & #5 Williams Jumbo, 3—42x36 MT 26 Jeffrey Metal Turnings Crushers, 60 GA Williams, SXT Thor Pennsylvania.

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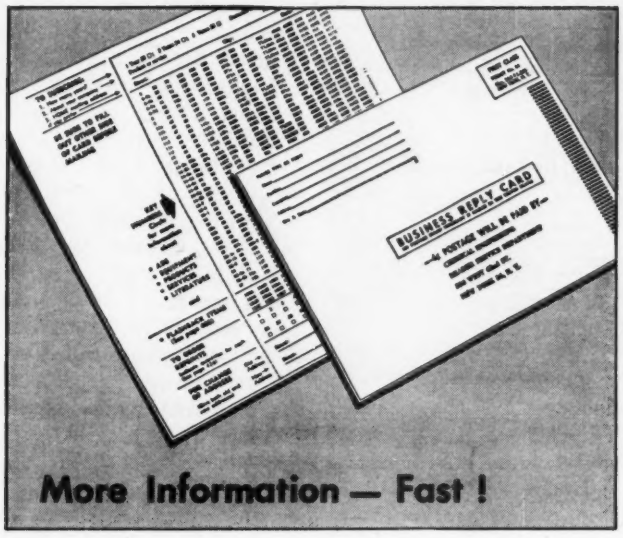

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Cooling 433A
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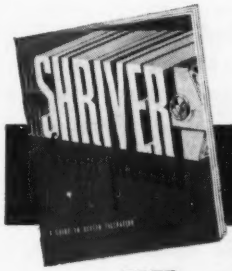
- Filter at Any Temperature
- Use Any Filter Media and Filter Aids
- Can Be Built in Any Capacity of Any Materials of Construction

Worth investigating this versatile, modern processing equipment



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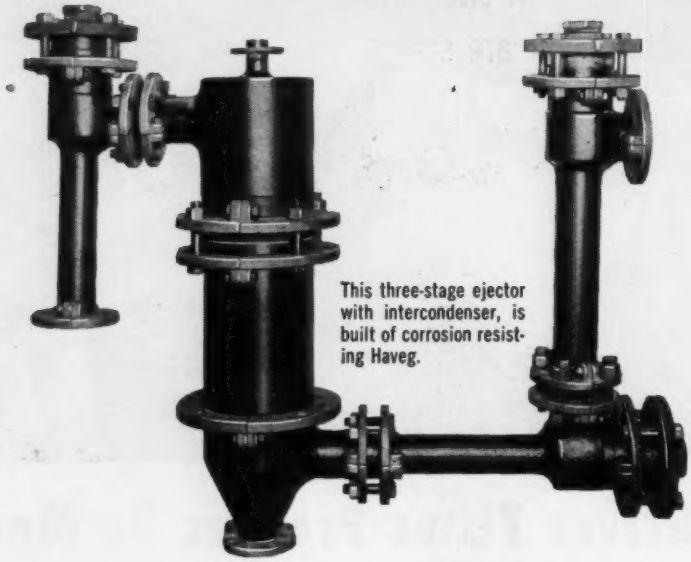
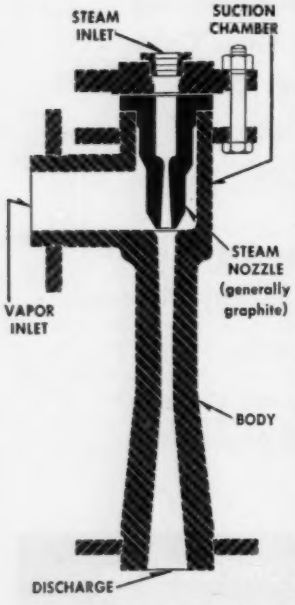


This three-stage ejector with intercondenser, is built of corrosion resisting Haveg.

ELLIOTT *Steam Jet* EJECTORS

TYPE H



Cross-section, showing construction details of Type H ejector. Conventional split flanges are used. Nozzle is easily replaceable.

When it comes to maintaining vacuum, while handling highly corrosive vapors, you can't beat these durable Elliott Type H ejectors. Made of Haveg, Permanite or similar corrosion-resistant synthetic resin material, they'll stand up to hydrochloric and sulphuric acids, wet chlorine, caustic, benzene and many other corrosive vapors, including some of the chlorinated aromatic compounds.

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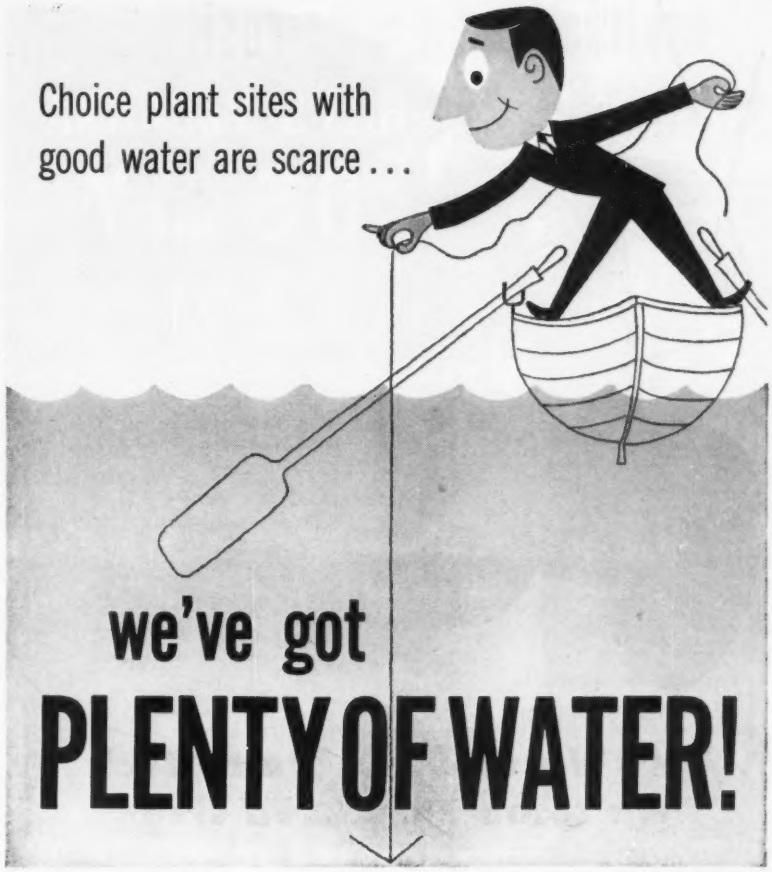

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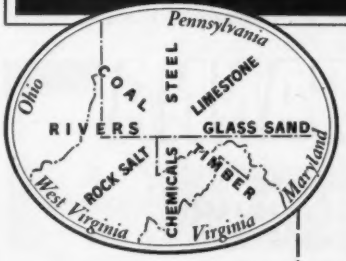

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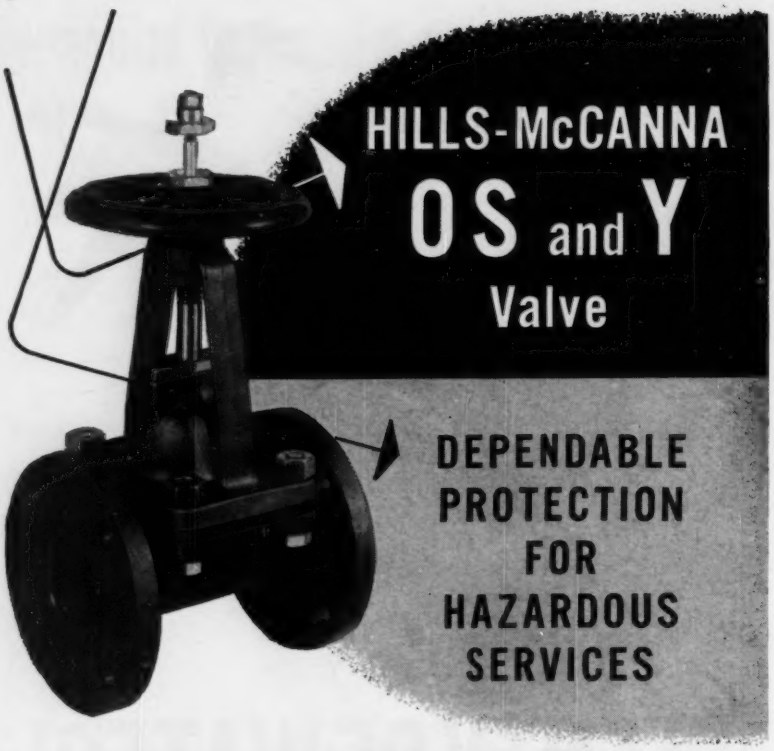

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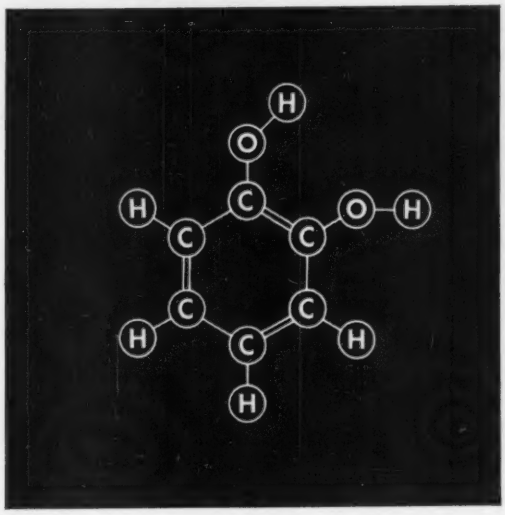
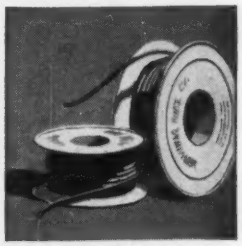
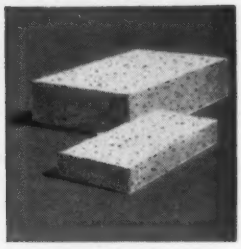
More interesting applications for versatile KOPPERS CATECHOL





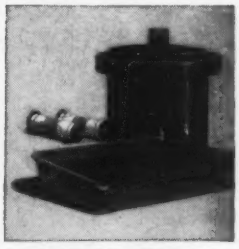
In the electrotinning of wire



For the vulcanization of rubber

In fur dyeing

In antiseptics, analgesics, astringents



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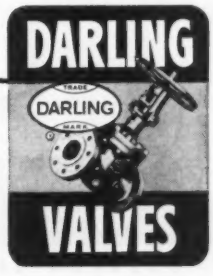
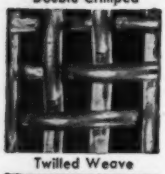


Flat Wire Mesh

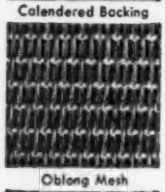
Double Intermediate Crimp

Single Intermediate Crimp

Double Crimped


Twilled Weave

Calendered Backing


Oblong Mesh

Plain Dutch Filter

Twilled Dutch Filter

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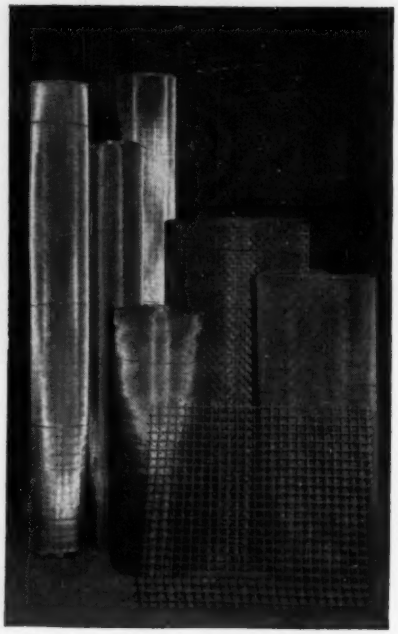

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Flashback

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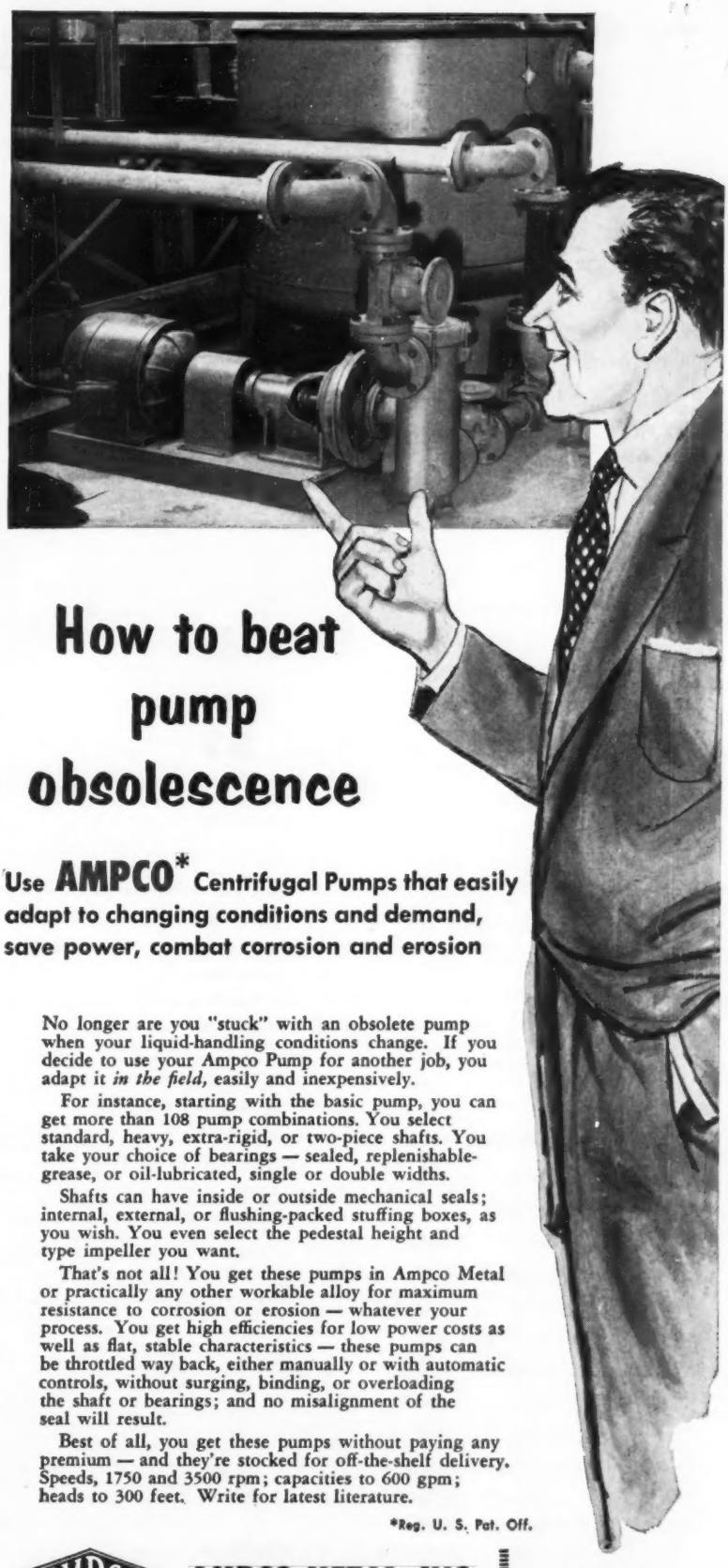

How to beat pump obsolescence

Use AMPCO* Centrifugal Pumps that easily adapt to changing conditions and demand, save power, combat corrosion and erosion

No longer are you "stuck" with an obsolete pump when your liquid-handling conditions change. If you decide to use your Ampco Pump for another job, you adapt it *in the field,* easily and inexpensively.

For instance, starting with the basic pump, you can get more than 108 pump combinations. You select standard, heavy, extra-rigid, or two-piece shafts. You take your choice of bearings — sealed, replenishable-grease, or oil-lubricated, single or double widths.

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That's not all! You get these pumps in Ampco Metal or practically any other workable alloy for maximum resistance to corrosion or erosion — whatever your process. You get high efficiencies for low power costs as well as flat, stable characteristics — these pumps can be throttled way back, either manually or with automatic controls, without surging, binding, or overloading the shaft or bearings; and no misalignment of the seal will result.

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Burbank, California

P-17

Guide to Technical Literature

Want to build up your files and keep them up-to-date? This comprehensive guide to available literature will help you do just that. They're yours—free—for the asking.

What It Contains . . .

This is a comprehensive listing of the latest literature you can now get from manufacturers on chemicals, equipment and services in all fields of interest to chemical engineers. It lists new publications just released, in addition to technical literature mentioned in the advertisements in this issue. The latter are identified by an asterisk (*) along side the company name.

For More Information . . .

You can get—and get fast—more information on any publication listed in this guide by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, fill in your name and address, then mail to us. Ask for as many as you need. Answers come to you direct from the companies putting out the literature.

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Chemicals

Absorbers, Ultraviolet.....Are added to plastics and protective coatings to prevent deterioration and discoloration caused by ultraviolet light. Company makes available complete information on line of Uvinuls.
420A Antara Chem. Div.

Acid, Acetic.....Acetic acid—glacial or standard strength, 80%-84% solutions. Aluminum tank cars or drums. Company announces the availability upon request of descriptive literature, samples and prices.
420B Crossett Chem. Co.

Acid Anhydrous, Hydrofluoric.....40 p. book contains valuable information concerning hydrofluoric acid anhydrous. Provides useful data for those who now use HF, or for those who are contemplating its use.
62a *Harshaw Chem. Co.

Acid, Ascorbic.....The antiscorbutic vitamin . . . antioxidant in food industry . . . reduces smoking time, improves cure color, retards fading in cooked & cured meat products, etc. Technical Information Sheets.
420C Mallinckrodt Chem. Wks.

Acid, Toluic.....A mixture of isomeric toluic acids, consisting largely of the meta isomer, with a smaller proportion of para toluic & minor amounts of ortho toluic & benzoic acids. Technical Bulletin No. 12.
420D Oronite Chem. Co.

Alcohol, Polyvinyl.....Lemols can be used as emulsifiers & stabilizers . . . in adhesives . . . for paper coatings & saturants . . . for textile sizings & finishes . . . for binders . . . etc. Request data & samples.
420E Borden Co.

Alicyclic Compounds.....Informative literature describes Arapahoe line of alicyclic compounds . . . for the pharmaceutical, perfume, and allied industries. Company also furnishes valuable product samples.
420F Arapahoe Chem.

Alumina, Calcined.....R-2003 Alumina offers advantages of better quality and lowered cost to abrasives, refractory, ceramic and glass manufacturers. Furnishes samples and a detailed Product Data Sheet.
86 *Reynolds Metals Co.

Boron Trifuloride.....Baker & Adamson's BF_3 . . . universal catalyst . . . for polymerization, alkylation, esterification, acylation and numerous other reactions. Complete information on properties & uses.
115 *General Chem. Div.

Butyrolactone.....Solvent for polymers including polyacrylonitrile, polystyrene, shellac, polyvinyl acetate, polymethyl methacrylate, etc. Announces availability of technical information and product samples.
420G General Aniline & Film Corp.

Carbon, Activated.....High density and high adsorbing capacity make G-32 an extremely efficient material in recovery, purification, and other uses. Available in wide range of grades and sizes. Request samples.
304 *Girdler Co.

Chemicals.....Mallinckrodt's flexible production facilities are geared to precision manufacture of chemicals from a few tons to carload lots. Brochure lists and describes company's chemicals and their uses.
277 *Mallinckrodt Chem. Wks.

Chemicals, Barium.....If you are working with lube-oil additives, company would like to furnish you with a copy of their new 24 p. product reference containing complete information on Westvaco Barium Chemicals.
420H Westvaco Mineral Products

2-Chlorallylidene Diacetate.....A new reactive monomer—presence of chlorine group in the molecule enhances copolymerization with such materials as vinyl chloride. Request literature and product samples.
420I Carbide & Carbon Chem.

Chloromethanes.....Valuable data on diverse uses & physical & chemical properties of chloromethanes—methylene chloride, methyl chloride, chloroform, carbon tetrachloride—in new, comprehensive 28 p. reference.
145 *Solvay Process Div.

Defoamers, Silicone.....Defoamers have proved their efficiency and versatility in countless applications. Offers a new booklet with complete information on Dow Corning Antifoam agents plus a product sample.
R325 *Dow Corning Corp.

Dispersants.....Describes Marasperse—the low cost, highly effective dispersant. Completely soluble in water; non-hygroscopic, non-fermenting, noncaking, free-flowing powder. Information in File No. W-130.
420J Marathon Corp.

Dispersants.....Sulfonates of low-cost, plentiful pine wood lignin disperse pigments, dyes, insecticides; stabilize fire foams; reduce boiler scale; etc. Request samples and Technical Bulletin No. 301.
420K West Va. Pulp & Paper Co.

Dispersing Agents.....To find out how Daxads can speed production, reduce processing costs or improve the quality of your product, request company's informative Bulletin No. D-5, "Daxad Dispersing Agents."
420L Dewey & Almy Chem. Co.

Glutaraldehyde.....A cross-linking agent for protein and polyhydroxy compounds . . . an intermediate for textile and paper chemicals. Makes available complete information in addition to product samples.
420M Carbide & Carbon Chem.

Latex.....WC-130 is designed as a high quality vehicle for interior wall sealers & coatings to provide superior color, toughness, & resistance to alkalis & cleaning compounds. Request Bulletins 1 & 225.
420N Bakelite Co.

Magnesium Stearate Purified.....A fine, white powder; odorless. Uses—a covering agent, a dry lubricant, bodying agent, gel-breaker and emulsifier. Descriptive Technical Information Sheet is available on request.
420O Mallinckrodt Chem. Wks.

N-Methyl-2-Pyrrolidone ..... Effective solvent for chlordane, lindane, toxaphene, phenyl mercuric acetate, 2,4-D, maleic hydrazide, etc. Announces the availability of technical information and product samples.
420P General Aniline & Film Corp.

Odorants, Gas.....30 p. Bulletin includes data on Calodorant "C" odorant, Calodorant "C" Special, Alert gas odorant, Oronite LPG odorant, etc. A comparative chart covers the chemical & physical characteristics.
421A Oronite Chem. Co.

Oils, Tall.....Seecotol whole tall oil—high quality, high in fatty acid, low in rosin acids. Tank cars or drums. Announces the availability of descriptive literature, samples and prices upon request.
421B Crossett Chem. Co.

Polybutenes.....Feature valuable advantages: high viscosity; minimum thermal decomposition residue; non-drying; color stable; non-migrating; low cost; etc. For details, request Technical Bulletin No. 12.
421C Indoil Chem. Co.

Polyethylene.....Makes available technical literature and a product sample of company's A-C Polyethylene—the low-molecular-weight polymer. Its low viscosity lets you blend with your present equipment.
339 *Semet-Solvay Petrochem. Div.

Polyvinyl Acetate Beads.....Ideally used for: low cost thickeners for inks, paints, lacquers, hot-melt coatings; metallic inks for use on cellophane, glassine, foil & plastics; etc. Data & samples of Lemac on request.
421D Borden Co.

Polyvinyl Materials.....Products made from Geon rigid vinyl include corrosion-proof pipe, fume ducts, tanks, trays, materials that can be machined, planed, sawed, drilled, and cemented. Offers technical information.
9 *B. F. Goodrich Chem. Co.

Reducing Agents.....If your process requires a reducing agent it will be to your advantage to investigate the complete line of Jacques Wolf Hydrosulfites & Sulfoxylates. Complete data & samples on request.
421E Jacques Wolf & Co.

Resins, Acrylic.....Lucite acrylic resins available with a wide range of molding characteristics & properties & in a variety of transparent, translucent & opaque colors. Offers descriptive literature on request.
257d *E. I. du Pont de Nemours.

Resins, Nylon.....Zytel is the du Pont trade-mark for a versatile group of long-chain synthetic polymeric amides exhibiting extreme toughness & strength. Complete data on properties & applications on request.
257c *E. I. du Pont de Nemours.

Resins, Plastisol.....Exon 654 is expressly created to impart excellent heat and light stability, physical toughness and chemical stability to your products. Request full information on entire product line.
52 *Firestone Plastics Co.

Resins, Polyethylene.....Tough, flexible Alathon polyethylene resin stands up well against abrasive slurries. Widely used in industrial pipe applications. Offers complete information on the properties and applications.
257b *E. I. du Pont de Nemours.

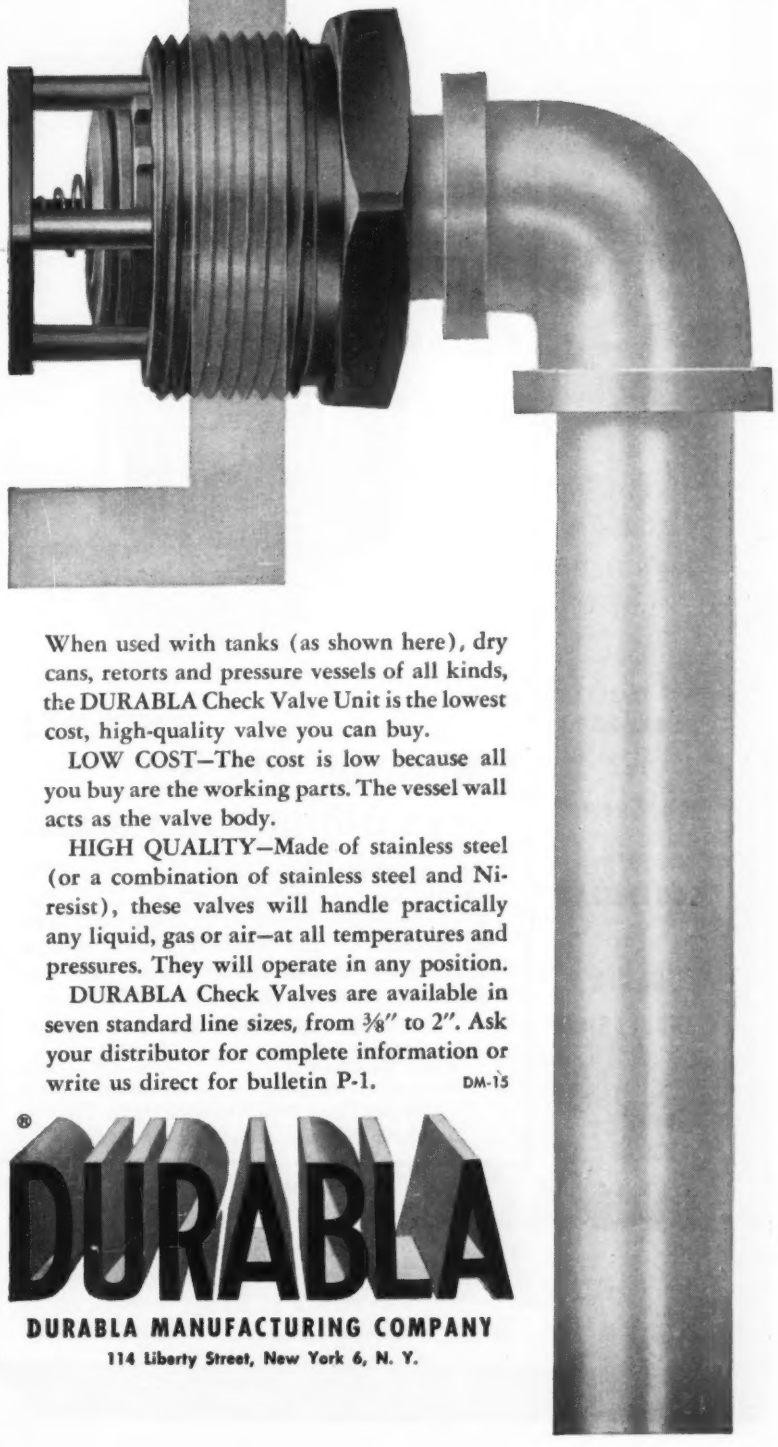
Resins, Tetrafluoroethylene.....Teflon tetrafluoroethylene resins used extensively in process industries. Offer chemical inertness, high heat resistance, low-temperature toughness, etc. Properties & applications.
257a *E. I. du Pont de Nemours.

Silica Gel.....A superior drying agent for natural gas. For detailed information and field performance data on the use of Davison silica gel for the drying of natural gas, request Technical Bulletin No. 201.
269 *Davison Chem. Co.

Sizing Agents.....Aquapel is an entirely new concept in sizing for the paper industry. Neither resin nor wax, Aquapel is a chemical compound—an alkylketene dimer. Request product sample & descriptive literature.
421F Hercules Powder Co.

* See explanation on p. 420

HERE is the ideal CHECK VALVE for tanks and other vessels



When used with tanks (as shown here), dry cans, retorts and pressure vessels of all kinds, the DURABLA Check Valve Unit is the lowest cost, high-quality valve you can buy.

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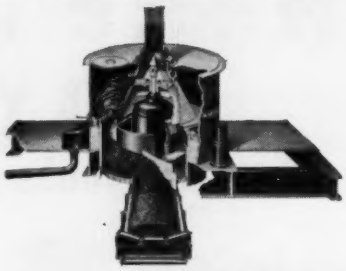
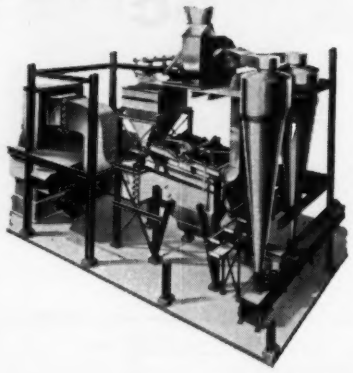


. . . MECHANICAL
McNally DRYCLONE separates at low cost

Here is high drying efficiency, with drying costs held to a few cents per ton. Integral drive without belts or gear train. Easy upkeep. Positive mechanical discharge to conveyor.



. . . THERMAL
McNally PULSO drys difficult materials

An up-draft type dryer that efficiently handles sizes in the difficult ½" x 0 range. Free moisture completely removed, with no effluent. Automatic control ensures that exact drying specifications are met day after day.

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LITERATURE . . .

Sodium Perborate.....Becco sodium perborate is widely used for dye development and in the manufacture of powder bleaches, cosmetics, etc. For complete product information, request detailed Bulletin No. 45.
422A Buffalo Electro-Chem. Co.

Sodium Stearate Purified Powder.....A fine, white powder; slight fatty acid odor. Thickening & wetting agent for creams, shampoos & water base ointments; detergent for dentrifices; etc. Technical Information Sheet.
422B Mallinckrodt Chem. Wks.

Stearates.....Offers Standard Stearates —all the most widely used types for every application . . . and Special Purpose Stearates—made to order to fit particular requirements. Makes available specification data.
422C Nuodex Products Co.

Surface Active Agents.....Dispersant NI-W is a nonionic surface active agent designed to offer outstanding cotton detergency, lime soap dispersive power, etc. Properties & characteristics in Bulletin No. 18.
422D Oronite Chem. Co.

Surface Active Agents.....Industry has been finding more & more use for versatile non-volatile surface active agent as such, as salts or oil-soluble soap form. Request literature & sample of Alkaterge-C.
422E Commercial Solvents Co.

Surface Active Agents.....Nonionic surfactant not only offers outstanding detergency, but it also provides thorough wetting, disperses solids, & emulsifies oil & grease. Complete technical data on Triton X-100.
422F Rohm & Haas Co.

Tar Bases.....Used importantly in such fields as drugs, dyestuffs, textiles, insecticides, adhesives, metal cleaning, their potentialities are almost unlimited. 96 p. covers uses, properties, test methods, etc.
422G Barrett Div.

Tetraaryloxysilane.....Illustrated, 17 p. describes Orsil AF-1. Includes data on physical properties, corrosion characteristics, physiological properties, heat transfer properties, etc. Bulletin 19.
422H Oronite Chem. Co.

Thread Compounds.....Big "D" Thread Dope (90% atomized metallic lead, 10% vehicle, with wonder Silicones added for plus performance) excels wherever thread compound is needed. Request sample and Brochure.
431 *C. H. Dragert Co.

Vitamin B_{12}.....A dark red, crystalline powder; practically odorless & tasteless. Uses—as anti-anemia factor in treatment of pernicious anemia, tropical & non-tropical sprue, etc. Technical Information Sheet.
422I Mallinckrodt Chem. Wks.

Vermiculite.....Remarkable new vehicle that turns liquid chemicals into free flowing solids . . . has 27,500,000 particles per lb. Request copy of the new Data Book on Vermiculite's properties & uses in industry.
422J Zonolite Co.

Construction Materials

Alloys.....Offers "Materials Selection Chart" . . . a 4 p. chart designed to assist in the selection of the most economical alloy for a given corrosive problem. More than 350 specific corrosives are included.
364c *Cooper Alloy Corp.

Alloys, Corrosion & Heat Resistant..... Presents a valuable "Alloy Reference Chart" . . . a 6 p. pamphlet listing alloy designations, applications, properties & analysis of corrosion & heat resisting alloys.
364d *Cooper Alloy Corp.

* See explanation on p. 420

Aluminum.....Process Industry applications of aluminum for producing everything from beer to bomb shells are thoroughly analyzed in illustrated, 80 p. book, "Process Industries Applications of Alcoa Aluminum."
96-7 *Aluminum Co. of America

Castings.....Haynes Investment Castings . . . in intricate shapes and alloys difficult to fabricate by other methods . . . resist wear, heat and corrosion. For complete details, request descriptive literature.
423A Haynes Stellite Co.

Castings.....Corrosion-resistant castings from created metals . . . to help solve your tough product design problems. Offers 40 years of experience in producing top quality castings. Request informative literature.
261 *Waukesha Foundry Co.

Castings.....Presents "Newscast" . . . an 8 p. bi-monthly publication devoted to reporting technical material of value to those interested in corrosion resistant castings, fittings, valves and pumps.
364r *Cooper Alloy Corp.

Castings, High Alloy.....Covers facilities for producing high alloy static & centrifugal castings & offers data on castings used for resisting high temperatures, corrosion & abrasion. 16 p. Bulletin No. 3354-G.
423B Duraloy Co.

Ceramics, Chemical.....Today's chemical ceramics feature superior characteristics: better heat-shock resistance; higher mechanical strength; closer dimensional tolerances. Complete details in Bulletin No. C-5.
102 *U. S. Stoneware Co.

Coating Systems, Protective.....Modern approach to maintenance-painting halts corrosion. Sixteen specialized protective coating systems cover requirements of hundreds of strong corrosives. Bulletin No. MC-8.
286b *United Chromium.

Coatings, Protective.....The "Amercoat 33/86 System" has proven amazingly helpful . . . to control corrosion where only minimum surface preparation is possible. For details, request descriptive literature.
233 *Amercoat Corp.

Coatings, Protective.....For any equipment or surface that can be uniformly baked . . . Plastisol compounds offer easy, economical way to apply long-lasting vinyl coating protection. Data in Bulletin No. VP-1.
286a *United Chromium.

Coatings, Protective.....Now . . . your own painter can "cold-galvanize" any steel surface with Dimetcote (100% inorganic zinc coating) . . . any place—anywhere—anytime. Request Dimetcote Technical Bulletin.
279 *Amercoat Corp.

Fabricated Equipment, Aluminum..... Product literature describes company's line of aluminum custom fabricated equipment, including pressure vessels, storage & processing tanks, heat exchangers, towers, etc.
BL393 *Washington Aluminum Co.

Fabrication, Metal.....Manufactures metal products for many industrial uses . . . from complete carbon-black plants to steel conveyor boxes. Designs, engineers and fabricates to specific needs. Full data.
424 *Boardman Co.

Fabrication, Plate.....Illustrated, 12 p. covers dozens of typical examples of plate fabrication work done by the company for chemical, refining, petrochemical, food and other process industries. Request Bulletin PF.
423C Downingtown Iron Wks.

Fabrication, Process Equipment.....With nearly 50 years experience in custom fabrication, Stover builds & designs tanks, pressure vessels & special weldments for all kinds of industry problems. Illustrated, 4 p.
423D Stover Steel Tank & Mfg.

* See explanation on p. 420

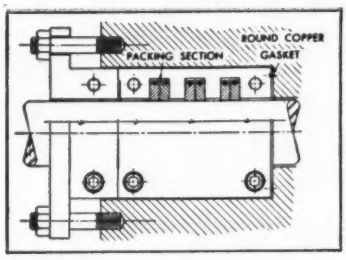
Left: Reciprocating air compressor

Below: Garlock 809 Floating Metal Packing split-case design

For air compressors, users report

GARLOCK SPLIT-CASE METAL PACKINGS

have 2 big advantages



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LITERATURE . . .

Fabrication, Stainless Steel.....Feature the techniques of fabricating equipment with round corners for efficient service—round corners are stronger . . . easier to clean. Guide provides complete information.
302 *S. Blickman, Inc.

Fabrication, Vessel.....Illustrated 32 p. brochure, "Prototypes in Boilerplate," describes art of fabricating vessels of odd shape & complex design for chemical, petro-chemical & nuclear energy industries.
424A Steel & Alloy Tank Co.

Insulating Sheet Material.....“Marinite For Driers, Ovens, Breechings and Housings” offers complete information on structurally strong sheet material which both builds and insulates. Illustrated, 16 p.
424B Johns-Manville.

Insulation.....Covers 10 properties of Thermalastic insulation that extend life of generators, synchronous condensers, frequency changers, large motors & other heavy rotating equipment in hard service. Booklet B-6506.
424C Westinghouse Elec. Corp.

Insulation, Blanket.....Outstanding chemical & physical characteristics of Eagle-Picher mineral wool provide maximum thermal efficiency at temperatures as high as 1200 F. Makes available a product sample.
74 *Eagle-Picher Co.

Insulation, Cellular Glass.....Will give you the maintenance-free insulating performance you need for your piping, tanks, spheres and other industrial equipment. Request sample and descriptive literature.
371 *Pittsburgh Corning Corp.

Insulation, Magnesia.....Revision of the “85% Magnesia Insulation Manual” with 80 p. of text, illustrations and tables has been made available. This edition (second) furnishes new engineering and product information.
424D Magnesia Insulation Mfrs.

Insulation, Pipe.....Lower heat losses, lower cost with new Snap*On glass fiber pipe insulation. Available in sizes that will fit pipe from ¾” to 33” nominal diameter, inclusive. Request Technical Bulletin SO-55.
147 *Gustin-Bacon Mfg. Co.

Irons, Nickel Alloy Cast.....64 p. reference features applications of “Ni-Resist” in 9 specific industries as well as in general industrial uses. Included are 96 figures, 15 tables and charts. Bulletin No. A-71.
424E International Nickel Co.

Molding Compounds, Fiberglas Reinforced.....Announces the availability of a unique fact file folder containing case histories and typical technical information on Fiberglas reinforced molding compounds. Illustrated.
424F Owens-Corning Fiberglas Corp.

Plastics.....Describes 7 new & improved transparent plastics. These materials promise greater stability, increased safety, lower maintenance, etc. Superior properties covered & applications suggested. Illustrated.
424G Homalite Corp.

Plastics, Glass-Reinforced.....Presents technical data on custom-molded parts of the new ACE glass-reinforced plastics. Covers principal advantages, typical applications, properties, etc. 12 p. Bulletin No. GRP-1.
424H American Hard Rubber Co.

Steels, Carbon Alloy.....Described as fastest machining leaded alloy steel in its carbon range, New Rycut 50 alloy steel is supplied in both annealed & quenched-&-tempered condition. Illustrated Bulletin 14-6.
424I Joseph T. Ryerson & Son.

Steels, Stainless.....Covers superior stainless steel sheets, strip, bars, plates, wire, forgings, etc. Data in informative 44 p. booklet, “Making the Most of Stainless Steels in the Chemical Processing Industries.”
275 *Crucible Steel Co. of America.

* See explanation on p. 420

Electrical & Mechanical

Belts, V-.....Links are quickly joined by easy-to-use cup-washers & T-screws to make up individual belts. Easiest v-belt to couple & uncouple. Lasts longer—more flexible. Request new Veelos TD & TE Catalog.
55 *Manheim Mfg. & Belting Co.

Casters.....Featuring Darnelloprene treads (a soft, resilient Neoprene rubber compound)....casters offer ease of movement, quietness, and protection for floors. Manual contains complete information.
R429 *Darnell Corp.

Chain, Roller.....Adaptable to power transmission or conveying. Positive, flexible, economical chain with high sustained efficiency. Lock-type bushings result in long roller chain life. 148 p. Data Book 2457.
63 *Link-Belt Co.

Connectors, Electrical.....Company announces availability of a fully illustrated Catalog with complete details of compact, all-weather, versatile connectors, designed to withstand moisture, acid, fumes & oil.
425A Titeflex, Inc.

Engine-Gear Sets.....Announces the publication of a new 8 p. booklet, "Nordberg Supairthermal Engine-Gear Set...for Driving Centrifugal Compressors & High Speed Pumps." Illustrated Bulletin No. 237.
425B Nordberg Mfg. Co.

Expanders, Tube.....For modern water tube boilers . . . Series 1500 tube expanders. Recommended for use with Drum or with short Header Mandrels. For complete product information, request illustrated Bulletin.
BL323 *Gustav Wiedeke Co.

Gaskets, Teflon-Jacketed.....Fully illustrated reference covers Chempro's lines of teflon jacketed gaskets, solid ring gaskets, teflon expansion joints and special teflon gaskets. Request Bulletin No. CP553.
425C Chemical & Power Products.

Motor Control.....Describes high-voltage, current-limiting, fused starters for co-ordinated control of squirrel-cage, synchronous, wound-rotor and multi-speed motors. Request 12 p. illustrated Bulletin GEA-6331.
425D General Elec. Co.

Motor Units.....Chapman's simple and rugged Motor Unit gives accurate, trouble-free control of large valves and sluice gates. Operates smoothly under the most adverse conditions. Complete details in Bulletin 51.
24 *Chapman Valve Mfg. Co.

Motors.....Choosing a Century motor, Performance-Rated to fit your particular job, is merely a matter of minutes when you use company's handy Application Guide. For your free copy, request Form No. 1700.
255 *Century Elec. Co.

Motors.....Covers new series of totally-enclosed & explosion-proof motors. Motors (Types J & E) engineered for operation where dangerous fumes, dusts, combustible materials, etc. are prevalent. Bulletin No. 1879.
357 *U. S. Elec. Motors

Motors.....Here is extra motor value—double-shielded bearing . . . large grease reservoirs . . . bolted-on bearing cap . . . labyrinth seals. For complete details on bearing design, request Bulletin 51B7225.
38 *Allis-Chalmers Mfg. Co.

Motors, Fan-Cooled.....Totally-enclosed, fan-cooled motors . . . for chemical plant applications. Feature long life, minimized maintenance and top efficiency. Details in Chemical Motor Bulletin No. CE-3379.
75 *Diehl Mfg. Co.

* See explanation on p. 420

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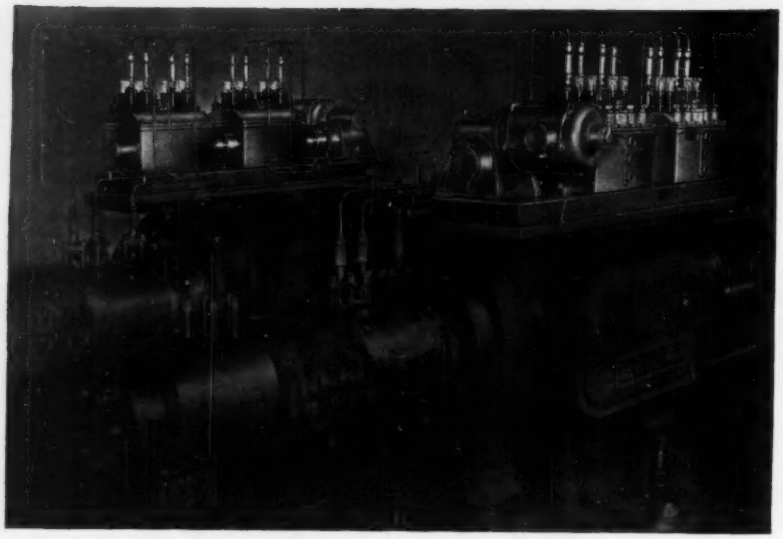

Where dependable lubrication under high pressure is essential to the efficiency of such equipment as pumps and compressors, Manzel has the answer. Models are available for operation against discharge pressures of up to 30,000 P.S.I.G. Manzel thus offers the Chemical Industry the means of insuring maximum life of oil seals — and competent assistance in engineering special lubricator installations to meet specific needs. For Force Feed Lubricators — and Chemical Feeders, too, — put Manzel at the top of your list of those to call.

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LITERATURE . . .

Packings.....For air compressors, split-case metal packings feature two big advantages: long, trouble-free life; can be installed without disconnecting the rod. Complete information contained in Bulletin 3889.
423 *Garlock Packing Co.

Reducers, Speed.....Describes versatile, Straight Line all-steel speed reducer (concentric type). High & low speed shafts suitable for v-belt, gear or chain as well as coupling connections. Bulletin 1104.
157 *Falk Corp.

Reduction Units, Speed.....New 100 Series Reductors are standard stock gear reduction units made in a full range of models and ratings for virtually all drive needs. Details in bulletin, "100 Series Reductors."
426A Boston Gear Wks.

Rims, Sprocket.....Operation of overhead valves solved thru use of Babbitt adjustable sprocket rim with chain guide. Fits any valve wheel—quickly installed—low in cost. Offers descriptive product literature.
BL427 *Babbitt Steam Specialty Co.

Seals, Mechanical.....Combining chemically impervious teflon with a balanced bellows design—Chemiseal external mechanical seals last longer & give unsurpassed performance. Details in Bulletin No. MS-954.
299 *U. S. Gasket Co.

Sheaves.....Stationary & motion control "Vari-Pitch" sheaves for speed variations up to 76 percent by means of pitch diameter adjustment, capacities 1 to 600 hp, are described in illustrated Bulletin No. 20B6082C.
426B Allis-Chalmers Mfg. Co.

Teflon Products.....Illustrates various of the many special molded & machined parts firm has fabricated from pure teflon, glass-filled teflon, glass- & carbon-filled teflon & zircon-filled teflon. Bulletin No. CP554.
L447 *Chemical & Power Products.

Transformers, Variable.....For use in hazardous atmospheres where a spark could cause untold damage, a complete line of standard explosion-proof & oil-cooled models are offered in many capacities. Bulletin P550.
426C Superior Elec. Co.

Transmitters, Power.....Unequalled for repeated start-stop machine operation. Use of transmitters makes it possible to simplify machines, reduce costs, improve operation, etc. Details in Bulletin No. CE-3303.
426D Diehl Mfg. Co.

Handling & Packaging

Bag Packers.....Model ET Bagpaker tapes & sews 15 bags per minute. Booklet ET gives you complete details and dimensional drawings, shows you how perfectly Model ET fits into your existing filling set-up.
347 *International Paper Co.

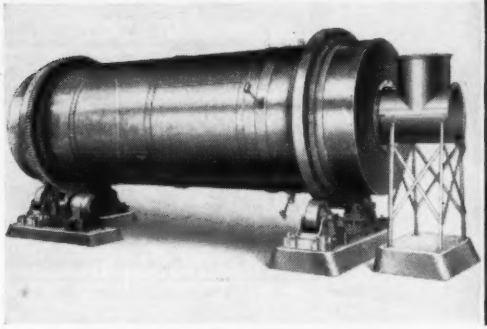
Carriers, Straddle Dump.....Completely illustrated Brochure describes company's new Straddle Dump Carrier. Included are performance characteristics, construction details, and engineering specications. 4 p.
426E Clark Equipment Co.

Caustic Soda Handling.....Offers a helpful, handy wall chart (17" x 23") giving 37 specific, successful suggestions based on accumulated plant experience for safely handling solid, liquid & flake caustic soda.
426F Diamond Alkali Co.

Conveyors.....Handle packages, parts, units—faster—at reduced cost with gravity or power roller, belt, slat, chain, wheel or push-bar conveyors. Specifications, drawing & application data in General Catalog.
L392 *Standard Conveyor Co.

* See explanation on p. 420

DAVENPORT ROTARY
AIR COOLER 6'0" dia. x 80'0" long



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This "Davenport" Rotary Air Cooler is of aluminum construction to cool molten Alum.

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NEWLY REDESIGNED for greater strength—easier, quicker, more solid assembly.

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Your supplier carries complete stocks. Call him — or write for details and prices.

Babbitt STEAM SPECIALTY CO.

5 BABBITT SQUARE, NEW BEDFORD, MASSACHUSETTS, U. S. A.

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Here are four 3200 gallon chemical storage tanks ready for shipment to Kuehne Chemical Company, manufacturing chemists in Elizabeth, N. J. These are the largest PLA-TANK tanks ever manufactured – 8' 4" diameter, 8' 4" deep with slanting bottoms for drainage.

Pla-Tank offers many advantages

The tanks are used for storing a 20% sodium hypochlorite bleach solution. PLA-TANK was chosen in preference to rubber-lined steel tanks for several reasons.

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- **PLA-TANK** is resistant to a wide variety of acids, fumes and temperatures.
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- **PLA-TANK** could be the answer to your tank installation problem. Let us help you the modern way – with **PLA-TANK**. Also available: stacks, hoods, ducts.

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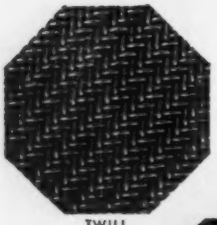
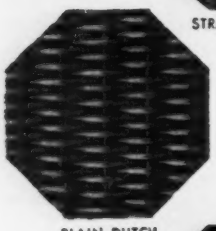
PLA-TANK, INC. DIVISION OF THE *Chemical* CORPORATION
Dept. 61, West Warren, Mass.

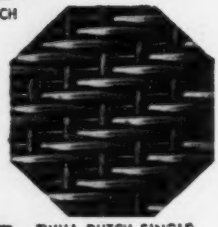
Newark Metallic Filter Cloth...


TWILL

STRANDED TWILL


PLAIN DUTCH

Enlarged approximately 3X


TWILL DUTCH SINGLE

TWILL DUTCH DOUBLE

Newark Metallic Filter Cloth does stop solids — the wedge-shaped openings allow only the filtrate to pass through. And, Newark Cloth is reversible, both sides being identical. Newark Metallic Filter Cloth is woven firmly and uniformly without loose wires, guaranteeing good filtration all over.

Newark Metallic Filter Cloth is available in a variety of weaves in *all* malleable metals, and is adaptable to practically all types of filters. When writing, please give us details on your process.

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Newark Wire Cloth COMPANY

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LITERATURE . . .

Detectors, Metal.....New Dings Universal Series Metal Detector will detect the presence of all magnetic metals in materials that pass through the Detector Search Coil. For details, request product literature.
R389 *Dings Electronics.

Dumpers, Drum.....Production up—costs down with Gifford-Wood's Drum Dumper—portable . . . semi-automatic . . . strong. Company offers their idea book on engineered materials handling systems.
TL327 *Gifford-Wood Co.

Feed Systems, Chemical.....Issues a new catalog on "packaged" chemical feed systems...for general water treating requirements and for individual chemical processing needs. Request illustrated Bulletin LP-1254.
428A Phila. Pump & Machy. Co.

Feeders.....Company announces the availability upon request of a revised and enlarged general catalog which describes its complete line of Pulva Sizers, Com-Bin Feeders and auxiliary equipment. Fully illustrated.
428B Pulva Corp.

Feeders.....50 p. of technical data, descriptions & photos of vibratory equipment, feeders, conveyors, power tools, shaft seals, diesel pile hammers, gasoline hammers, selenium rectifiers, etc. Catalog No. 554.
428C Syntron Co.

Feeders.....Describes and illustrates Fuller's line of roll and vane-type feeders and rotary valves. Feeders are designed to handle a large variety of dry pulverized and granular materials. Bulletin No. F-5.
428D Fuller Co.

Feeders.....Fully illustrated reference describes company's Rotodip Model 65 continuous volumetric feeder for liquids. Covers feeder's construction, its operation and materials handled. Bulletin No. 65-H12A.
428E Omega Mach. Co.

Feeders, Weigh.....Exact Weight weigh feeders help produce a more uniform product, reduce rejects to a minimum and effect a great saving in material. Complete data on weigh feeders for plastic molding.
TL329 *Exact Weight Scale Co.

Idlers, Suspension.....Covers neoprene belt conveyor idler of cable suspension type which resists most chemicals, has excellent resistance to abrasion, does not deteriorate in oil, etc. Bulletin No. LD-103E.
7 *Joy Mfg. Co.

Magnets, Suspended.....Rectangular suspended separation magnet cures tramp iron headaches on fast-moving conveyors, particularly when material is wet. Find complete product information in detailed Bulletin 25D.
40 *Stearns Magnetic.

Materials Handling.....When time is important in handling dry materials in bulk . . . rely on Fuller systems (Fuller-Kinyon, Airveyor, Airslide, Fuller-Fluxo). Data in "How To Pull Dollars Out of Thin Air."
68 *Fuller Co.

Materials Handling, Bulk-Flo.....Equipment designed to reduce handling costs on wide range of materials. Features ability to feed, convey, elevate in one compact, fully enclosed assembly. 28 p. Book 2475.
15 *Link-Belt Co.

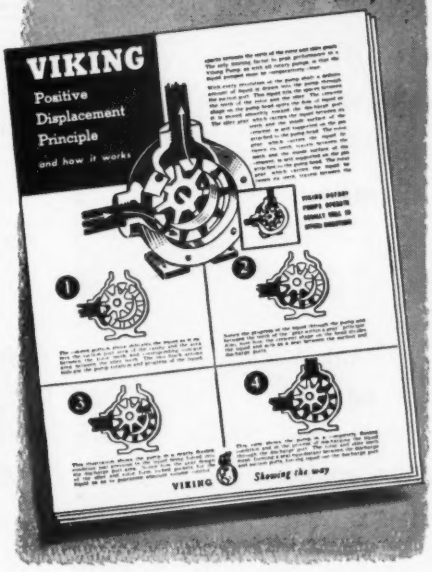
Materials Handling Equipment.....Folder covers company's line of tote boxes, conveyors, cranes, elevators, lifts, pallets, racks, shipping containers, skids, tanks, tractors, trailers, trucks, etc. Folder No. 1206 MH.
428F Market Forge Co.

Scales, Bagging.....Depend on the E-50 to give you fast accuracies of ± 1 to ± 2 oz., or better. Bagholders, manual or air-operated, are available. For complete details, request illustrated Bulletin 3749A.
37 *Richardson Scale Co.

* See explanation on p. 420

NEW

28 page Viking
General Purpose
Pump Catalog



The Viking pump line exceeds all others in the rotary pump field. This one fact alone means you can have a pump to really fit your needs . . . one that is efficient for your job.

Send today for the new 28-page catalog giving complete data on 306 General Purpose Viking pump models. Capacities from ½ to 1050 gallons per minute.

In addition, there are 450 other cataloged Viking pumps, plus thousands of special designed models to fit your needs. Viking is truly the pump designed to do your job better.

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See our catalog in Sweets

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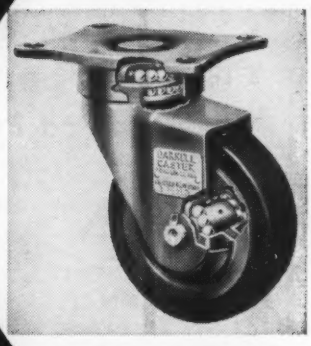
CASTERS & E-Z ROLL WHEELS
for the chemical industry



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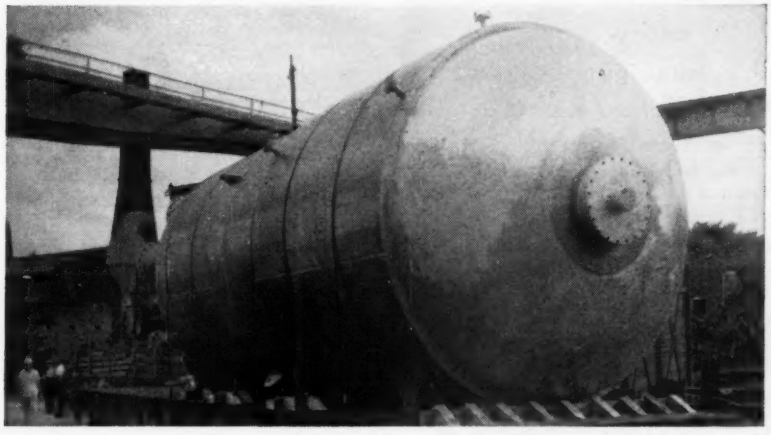

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- VESSELS
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• *We invite your inquiries for high pressure storage tanks, elevated tanks, acid or oil storage tanks, bins, boilers, stacks, etc.*

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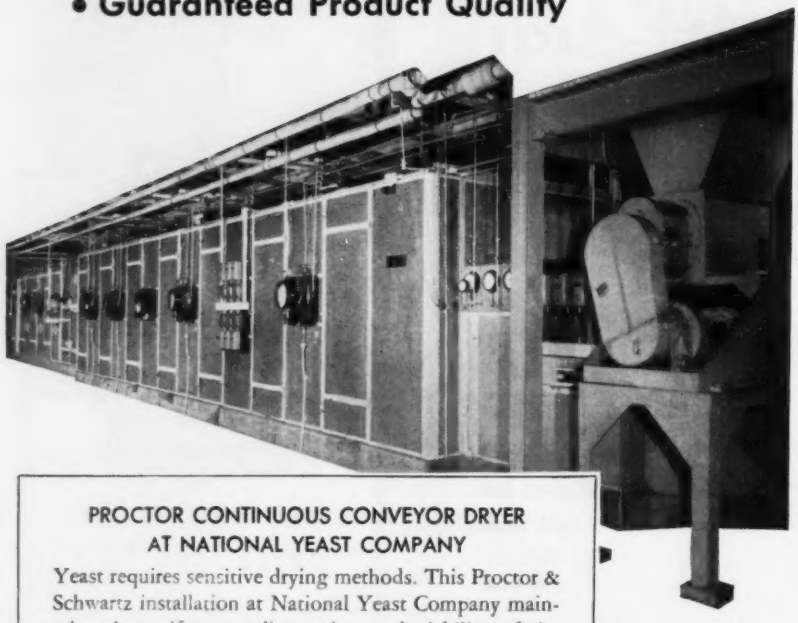

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AT NATIONAL YEAST COMPANY

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Proctor equipment provides the control and flexibility essential to profitable drying performance. Many wet-solid materials heretofore unsuited to conveyor drying can now be handled with speed and efficiency. And, as with all Proctor equipment, guarantee *is in terms of finished product produced.*

WRITE FOR BULLETIN # 390

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- Tray Dryers
- Truck Dryers
- Pre-forming Feeds
- Continuous Conveyor Systems
- Spray Dryers

PROCTOR & SCHWARTZ, Inc.

Manufacturers of Industrial Drying Equipment and Textile Machinery

Philadelphia 20, Pa.

LITERATURE . . .

Separators, Magnetic.....Ferrofilters remove contaminating ferrous particles from liquids and slurries by magnetic action with a maximum of efficiency and a minimum of cost. Request detailed Bulletin 16-E.
R445 *S. G. Frantz Co.

Skids.....Manufacturers of material handling equipment announce availability of literature on Steeleg Skids. Any width and length...plain, box-top or stake platform. Request illustrated Catalog No. 4382.
430A Barrett-Cravens Co.

Tanks, Pla-Tank.....Manufactured from long-life, resin-bonded glass fiber laminate, offers a solid uniform material. Resistant to wide variety of acids, fumes & temperatures. Request descriptive Data Sheets.
R427 *Chemical Corp.

Tanks, Stainless Steel.....Company makes available descriptive literature covering their line of highest quality stainless steel tanks (all types—storage—process) and agitators (all types—portable—built-in).
TL325a *Arthur Colton Co.

Tractor-Shovels.....Two new Payloader tractor-shovels (Model HU 1 cu. yd. & Model HH 1½ cu. yd.) offer many features: more horsepower; easy to operate; accessibility; torque-converter drive; etc. Full data.
49 *Frank G. Hough Co.

Tractor Trailer Systems.....The Guide-O-Matic tractor is completely automatic...neither operator nor physical connectors are required for operation. Find complete data in illustrated Bulletin No. 552-1.
430B Barrett-Cravens Co.

Trolleys, Ball Bearing.....Covers new line of trolleys for overhead conveyors—one of the most versatile & flexible conveying mediums. Includes description & dimension data on the entire line in 20 p. Book 2536.
430C Link-Belt Co.

Trucks, Fork.....Fully illustrated literature describes all the specifications and aspects for efficient operation of the new Yale K-46 electric, standup, hydraulic lift truck. Bulletins Nos. 5111, 5112 and 5113.
430D Yale & Towne Mfg. Co.

Trucks, Fork.....Company makes available upon request descriptive literature covering their Telescopic Powerox TTF-20T . . . telescopic tilting fork truck. Capacity to 3000 pounds. Illustrated Bulletin No. 551-2.
430E Barrett-Cravens Co.

Vibrators, Electric.....Fully describes & illustrates complete company line. Provides specifications & prices, & covers Cleveland's silent, Eccentric Weight Vibrators & Electro-Magnetic Vibrators. Catalog No. 11.
430F Cleveland Vibrator Co.

Heating & Cooling

Boilers, Packaged Automatic.....Offer valuable features: low-cost, space saving installation; fast steaming; instant response to load changes; quick fuel change-overs; clean, dry steam; etc. Data in Bulletin 1220.
87 *Orr & Sembower.

Burners, Incinerator.....Company's recently developed small, packaged burner provides an effective method for complete incineration of waste materials. Full specifications described in Bulletin No. H-51.
430G Eclipse Fuel Engrg. Co.

Coils, Heating & Cooling.....Aerofin Smooth-Fin coils offer you greater heat-transfer per sq. ft. of face area . . . lower airway resistance—less power per c.f.m. Complete details in Bulletin No. S-55.
440 *Aerofin Corp.

* See explanation on p. 420

LITERATURE . . .

Condensate Control .....Cochrane C-B System of condensate control improves heat transfer equipment...returns condensate to boilers at high temperature and pressure. Complete data contained in Publication 6025.
431A Cochrane Corp.

Coolers, Cascade.....Designed for cooling corrosive liquids and gases. Low initial cost and maintenance, radiused returns for low pressure drop as well as redwood waterguide strips. Request Catalog No. S-6820.
353e *National Carbon Co.

Coolers, Rotary Air.....Company furnishes complete information on the Davenport rotary air cooler (6'0' dia. x 80'0" long). Cooler is of aluminum construction to cool molten alum. Request Catalog "A."
TL427a *Davenport Mach. & Foundry.

Coolers, Sample Fluid.....For sampling high temperature process fluids—reduce sample process fluid temperatures from 60°F to 100°F at pressures up to 1500 psi. Details in fully illustrated Catalog.
18-9a *Young Radiator Co.

Dampers, Pulsating.....Company announces the development of a pulsating damper which provides better fuel economy and steadier kiln operation for its Air-Quenching cooler. Request literature, No. SN-23.
431B Allis-Chalmers Mfg. Co.

Exchangers, Film Type.....Vogt film type exchangers are operating with real economy of first cost, operation & maintenance in power, petroleum, & chemical industries. Typical installations in Bulletin No. HE-7.
352 *Henry Vogt Mach. Co.

Heat Exchangers.....Describes how equipment offers: chemical resistance to practically all corrosive fluids; resistance to severe thermal shock; high heat-transfer rates; low maintenance; etc. Catalog S-6740.
353e *National Carbon Co.

Heat Exchangers.....Impervite impervious graphite withstands 200 psi in new Cross-Bore heat exchanger—immune to almost all corrosives, possesses truly uniform heat transfer, etc. Catalog offers full details.
R393 *Falls Industries.

Heat Exchangers.....New Young stainless steel heat exchangers offer greater initial & operating economies for heating or cooling liquids & gases used in the processing industries. Request illustrated Catalog.
18-9b *Young Radiator Co.

Heat Exchangers.....Covers complete line of Karbate brand impervious graphite shell & tube heat exchangers. Engineered for maximum corrosion resistance & minimum maintenance. Request Catalog Section S-6840.
353g *National Carbon Co.

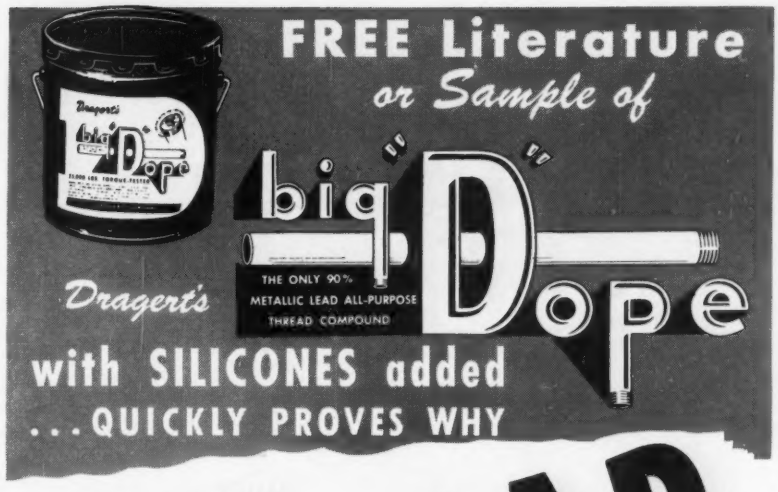
Heat Exchangers.....Aero heat exchanger cools liquids & gases by evaporative cooling with atmospheric air, removing the heat at the rate of input, controlling temperature precisely. Data in Bulletins 120 & 124.
438 *Niagara Blower Co.

Heat Exchangers.....Fully illustrated bulletin provides the complete facts on "Holo-Flite" Processor savings and how this field-proven unit can save space, time, and money on your processing operation. 8 p.
370 *Western Precipitation Corp.

Heat Transfer Apparatus.....Votafor heat transfer apparatus can improve efficiency and product quality in numerous processes. Company makes available a Heat Transfer Data Book containing complete information.
2 *Girdler Co.

Heaters, Air, Direct Fired.....Readily adaptable to wide variety of uses in ovens, kilns, dryers, etc. Includes information on applications, operation and typical sizes, in fully illustrated Bulletin No. 104.
456 *Thermal Research & Engrg.

* See explanation on p. 420



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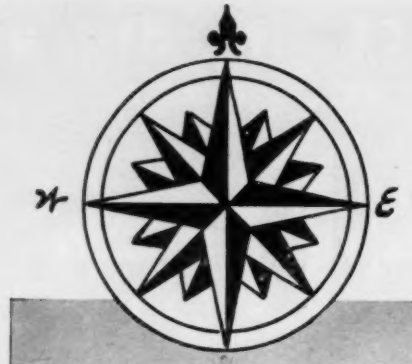

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New York Office: Graybar Bldg. Established Since 1910

LITERATURE . . .

Heaters, Unit.....Gives full details on the right units to handle your heating, ventilating or makeup air problem—including air diffusion distances for each unit & capacity up to 35,000 cfm. Bulletin 3704A.
13 *Buffalo Forge Co.

Platecoils.....Designed for tank heating and cooling problems due to inefficient pipe coils. These cost-saving platecoil heat or cool 50% faster and take 50% less space in the tank. Offers Bulletin No. P61.
60 *Tranter Mfg.

Refrigerating Machines, Absorption..... Produce large-capacity cooling from steam—have no major moving parts—use plain water as a refrigerant. Details in new 36 p. fully illustrated Catalog No. A.L.A. 30-F-22.
432A Carrier Corp.

Thermo-Panels.....You save space & heat or cool more efficiently . . . for these scientifically designed units are an economical replacement for pipe coils. Request Technical Data Bulletin and Price List.
366 *Dean Products.

Traps, Steam.....Impulse steam traps offer valuable features: get equipment hot in a hurry—& keep it hot; good for all pressures without change of valve or seat; easy installation; etc. Request Trap Selector.
273 *Yarnall-Waring Co.

Traps, Steam.....Larger valve orifice saves four ways: initial cost; upkeep expense; warm-up time; production time. Six types for every process, heat, power use. Complete information in Trap Catalog 953.
334 *W. H. Nicholson & Co.

Tubes, Condenser.....Announces availability of 156 p. Bridgeport Condenser Tube Handbook containing helpful data on condenser tube alloys, Duplex tubes, corrosion of all types & numerous other subjects.
58 *Bridgeport Brass Co.

Tubes, Condenser.....For condenser & heat exchanger tubes & plates specify Revere—cupro-nickel—30%, 10%; admiralty metal; arsenical copper; aluminum bronze—5%; etc. "Life Extension for Condenser Tubes."
267 *Revere Copper & Brass.

Tubes, Heat Exchanger & Condenser .....Makes available a new 12 p. reference furnishing detailed information on stainless steel tubing for heat exchangers and condensers. Request illustrated Brochure No. HES-1.
432B Republic Steel Corp.

Instruments & Controls

Amplifiers.....Describes Model "P" DC Amplifier—a new electronic low-voltage linear amplifier designed to increase speed & accuracy of almost all low level DC voltage measurements. Illustrated Bulletin MSP-111.1.
432C Hagan Corp.

Comparators.....Fully illustrated. 100 p. tells how to use pH and chlorine control for water supplies, process solutions, production processes in 34 basic industries. Also covers complete line of comparators.
L449 *W. A. Taylor & Co.

Control Systems.....Describes an economical multi-function control system—Synchro-Scan Supervisory Control. Illustrates individual components & a complete typical supervisory control system. Bulletin No. 240-M6.
432D Builders-Providence.

Controllers, Indicating.....Series 540 "On-off" indicating controller . . . is a rugged, durable & accurate remote indicating temperature control instrument designed for general industrial use. Bulletin No. MC122.
363a *Fenwal, Inc.

* See explanation on p. 420

LITERATURE . . .

Controllers, Indicating.....Offers data on new Series 560 controller . . . with revolutionary thermistor principle of operation for kilns, ovens, furnaces, extruding, air heaters, etc. Illustrated Bulletin No. MC123.
363b *Fenwal, Inc.

Controls, Cooling.....Covers new self-powered T44 Cooling Control which holds temperature of cooling water in jackets or coils of equipment such as compressors, oil coolers, stills, etc. Supplement 1-Bulletin 700-A.
433A Sarco Co.

Controls, Level.....Tektor level control indicates or controls level of fluids, powder, solids (conducting or non-conducting). Features low first cost . . . low operating cost. Request informative literature.
303b *Fielden Instrument Div.

Controls, Pressure & Temperature..... The new Cash Standard Type 51 pressure pilot and temperature pilot . . . provides precise, dependable control of pressure and temperature. Details in Bulletin No. 978-A.
225 *A. W. Cash Co.

Controls, Refrigeration.....Phillips Level Eye lets you "see" level of liquids in pressure systems. Low cost, simple to install. . . for temperatures from —50° to 250°F. Request Level Eye Bulletin.
TL393 *H. A. Phillips & Co.

Gages, Liquid Level.....Presents valuable data on liquid level gages: reflex; thru vision; tubular. Standard equipment in leading refineries and industrial plants all over the world. Request complete Catalog.
R323 *Strahman Valves.

Gages, Strain.....Baldwin-Lima-Hamilton announces the availability upon request of their new 1955 price list for SR-4 strain gages, instruments, accessories, and cements with revised quantity discounts. 12 p.
433B Baldwin-Lima-Hamilton Corp.

Gages, Tank.....Company makes available pertinent information on their line of 100% automatic Liquidometer tank gages for gaging liquids of all kinds. Gages are approved by the Underwriters' Laboratories.
TL445 *Liquidometer Corp.

Indicators, Electronic Level.....For accurate, continuous level measurement of liquids or divided solids. Feature savings in initial cost and in maintenance. Complete new instrument information available.
303a *Fielden Instrument Div.

Indicators, Temperature.....Describes Thermotubes—a graded series of sealed-in-glass temperature indicators which change appearance irreversibly from white to black at predetermined temperatures. 6 p.
433C Paper Thermometer Co.

Indicators, Temperature.....You can measure temperature of almost anything—gases, solutions or solid objects—quickly & accurately, from a distance, with new Thermo-O-Meter Model 388. Details in Form A-88.
433D Simpson Elec. Co.

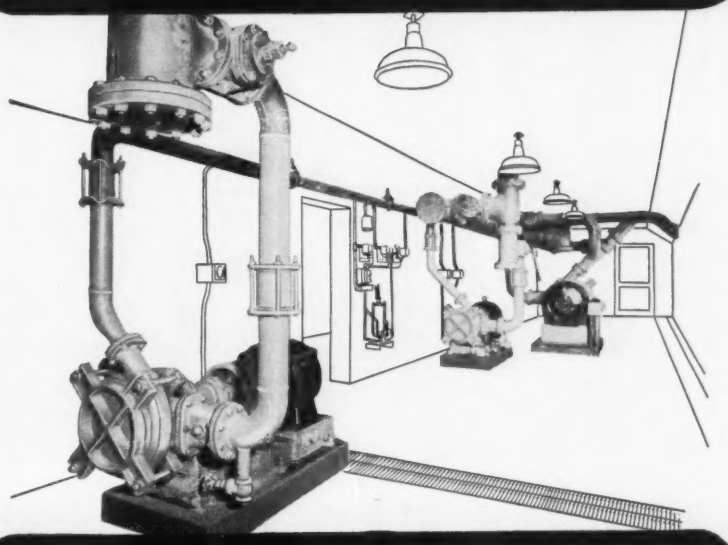
Instrumentation.....Versatile ElectroniK instruments increase speed, accuracy of cooling tower research. For complete reference data, request reprint of article—Third Quarter Issue, "Instrumentation."
64-5 *Minneapolis-Honeywell.

Instruments.....New 64 p. booklet, "Laboratus," lists 350 of company's manufactured and specialty instruments, including a current price list. Photographs and descriptions of new and improved products.
433E Central Scientific Co.

Instruments.....Process control instruments standardized & stocked for immediate shipment from Hatboro, Pa.; Chicago, Ill.; Houston, Tex.; & Los Angeles, Cal. described & illustrated in new 24 p. Catalog No. 2.
433F Fischer & Porter Co.

* See explanation on p. 420

Handles extremely thick slurries with high specific gravities



MORRIS Type R SLURRY PUMP

Heavy viscous slurries with solids ratios as high as 70% by volume are not unusual loads for a Morris Type R Slurry Pump.

A case in point is this Morris installation at the Missouri Portland Cement Co., St. Louis, Mo. The two Morris 3R Pumps in the foreground each handle 200 GPM of a cement slurry at 64% solids with 1.66 specific gravity. Speed is 1180 RPM. The 6R Pump in the background handles 600 GPM of the same slurry at 880 RPM.

Long operating life... little or no maintenance

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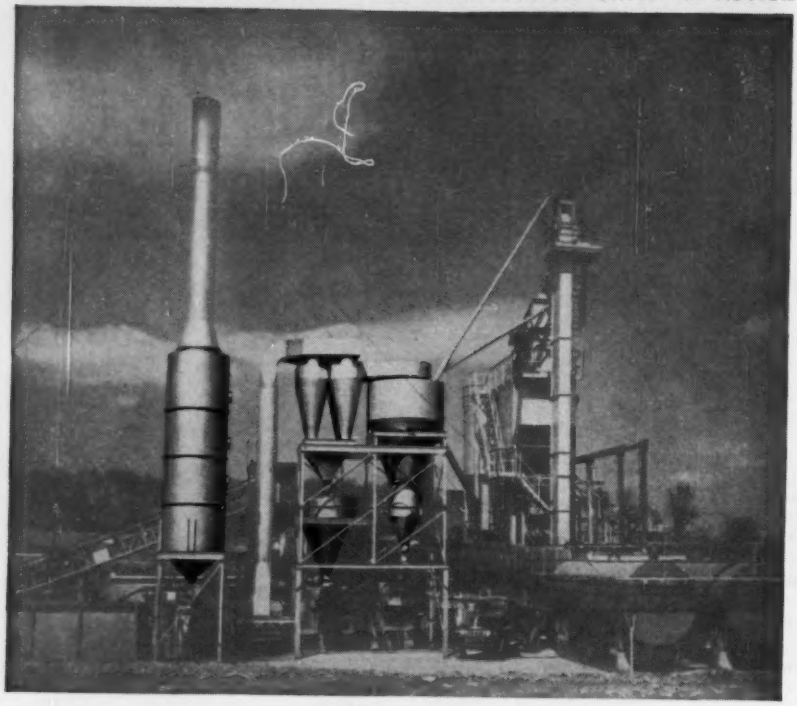

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save a mountain of usable product fines

At normal production rate, this typical installation of the Ducon Cyclones and Centrifugal Wash Collector will pay for itself in short order. These special Ducon "package" units are teamed to provide maximum recovery and dust control for Rotary Dryer Operations. Type LD and SD Cyclones recover, at high efficiencies, usable product from the exhaust gases in the dry state. One of several types of Ducon Washers, employed for final stack clean-up, remove the extreme fines and discharge clean gas to the atmosphere. Washing liquid can be re-circulated to effect complete recovery of all material processed. Perhaps your dust collection problem has a parallel among the many we have already solved in the 20 years of our specialization.

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LITERATURE . . .

Load Cells.....“Packaged Precision Measurement” can help solve your problems. To obtain detailed information concerning SR-4 Device applications and instrumentation, request illustrated Catalogs.
265 *Baldwin-Lima-Hamilton Corp.

Measurement, Temperature.....The Alnor Pyrocon combines laboratory precision with production tool ruggedness to give you fast, accurate answers to all surface temperature problems. Request Bulletin.
L437 *Illinois Testing Labs.

Meters.....Handle more than 150 liquid chemicals & food ingredients. Sizes from 25 to 1000 gpm. Bronze construction. Feature excellent reputation for sustained accuracy & low maintenance. Data Book No. 566Q.
308 *Neptune Meter Co.

Meters, Electricontact.....Now—explosion-proof—a new Niagara electricontact meter . . . for automatically measuring and controlling liquids in hazardous atmospheres. Complete details in Bulletin No. 35.
312 *Buffalo Meter Co.

Potentiometers, Null-Balance.....From simplest indicator to most complete standard controller—every Speedomax H combines compactness with “big instrument” performance. Details of features in Die-Out ND46(1).
59 *Leeds & Northrup Co.

Recorders.....Offer valuable features: pre-calibrated plug-in receiver units; up to 4 pneumatic or electronic receivers—or 2 receivers & 2 integrators; etc. Product Spec. E12-5 & actual chart sample on request.
278 *Bailey Meter Co.

Recorders, Multi-Point.....Feature simplified design, circuitry and construction. The chart mechanism is rugged, but so simple in form that there is little or no maintenance. Request descriptive Bulletin.
303c *Fielden Instrument Div.

Recorders, Temperature.....Newly designed Model “1000” Auto-Lite recorder gives permanent proof of temperature behavior. Request valuable catalog describing the many styles of recorders and indicators.
T319 *Electric Auto-Lite Co.

Recording Systems, Oscillographic..... From lathe cutting forces to telemetered aircraft data . . . Sanborn oscillographic recording systems prove their versatility. Catalog & technical data on request.
358 *Sanborn Co.

Regulators, Temperature.....Duo-matic regulator for controlling steam flow in a single unit, with a single internal pilot valve—controls automatically both temperature & pressure conditions. Bulletin 5307.
160 *Leslie Co.

Rotameters.....Fully illustrated 8 p. reference furnishes detailed information on Brooks armored rotameters ...for high pressure and temperature —fluid flow rate—measurement and control. Request Bulletin 130.
434A Brooks Rotameter Co.

Spectrophotometers.....Versatile and accurate, the G-E spectrophotometer has a range of 380 to 700 millimicrons. Instrument will measure both transparent and opaque samplings. Data in Bulletin No. GEC-307.
89 *General Elec. Co.

Telescopes, Industrial.....A.C.M.I. Borescopes permit close-up visual examination of interior areas & surfaces not otherwise visible. They save time & money & prevent costly dismantling. Request Booklet.
BR437 *American Cystoscope Makers.

Timers.....“Atcotrol” with dial setting incorporates high accuracy, compactness, flexibility & low cost for timing & sequencing of electrical load circuits on machinery & process operations. Bulletin No. N-140.
434B Automatic Temperature Control.

* See explanation on p. 420

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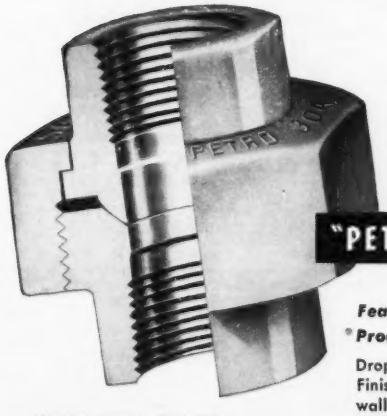

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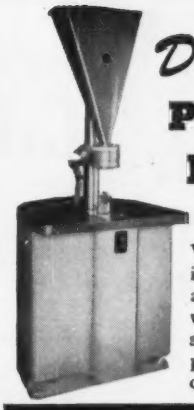

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LITERATURE . . .

Pipe, Fittings, Valves

Fittings, Pipe.....Presents newest catalogue of stainless steel pipe fittings which shows all standard pipe fittings and flanges, flanged fittings, butt weld fittings, etc. Request fully illustrated Catalog No. 653.
313a *Camco Products.

Fittings, Polyvinyl Chloride.....Company announces the development of new, smaller sizes of polyvinyl chloride fittings and adaptors for connecting polyethylene and other flexible tubing. Details in Catalog No. 102.
436A S. & C. Mfg. Co.

Fittings, Stainless Steel.....Quikupl Stainless Steel Fittings . . . makes available valuable Technical Manual which covers the design, applications & limitations of revolutionary new type stainless fittings.
364g *Cooper Alloy Corp.

Fittings, Stainless Steel.....New stainless steel fittings will assure you of long, trouble-free service in tough piping applications . . . will reduce down-time and cut maintenance costs. Bulletin No. S-3-55.
309 *Watson-Stillman Fittings.

Fittings, Stainless Steel.....Speedline fittings simplify pipeline design. Details of the greater design flexibility possible with Speedline fittings . . . at lower cost . . . in new fully illustrated catalog.
BL391 *Horace T. Potts Co.

Fittings, Stainless Steel.....Company announces the availability upon request of a complete stainless steel fittings catalog giving engineering drawings, dimensions and basic material data. Catalog No. 55F.
364i *Cooper Alloy Corp.

Flange Specifications.....Company announces the development of a new Flange Specification table for ASA and MSS Flanges in a convenient, slide rule form. Pocket-size reference is available upon request.
313b *Camco Products.

Hose, Metal, Flexible.....Illustrated, 12 p. covers full range of company's manufacture in Rex-Weld corrugated metal hose, Rex-Tube convoluted hose, Rex-Flex stainless steel flexible metal hose, etc. Catalog 147.
436B Flexonics Corp.

Hose, Metal, Flexible.....Ideal for difficult fluid and gas handling jobs. Durable and leak-proof for conveying, controlling movement and vibration, correcting misalignments, etc. Full details in Bulletin No. 20D.
340 *Atlantic Metal Hose Co.

Joints, Expansion.....Describes & illustrates ExpandZorber—a complete line of flexible pipe connections used to solve vibration & expansion control problems in industrial & process piping. Request Catalog EZ-55.
436C T. R. Finn & Co.

Joints, Swing.....Covers information & detailed specifications on 35 styles of bronze & steel, plain & flanged swing joints. Recommendations & data on use, care & maintenance of equipment. 12 p. Catalog No. F-8.
137 *OPW Corp.

Nozzles, Spray.....Company provides a 48 p. industrial catalog with full data on thousands of standard and special nozzles—for every type of spraying. Also information on related equipment. Catalog No. 24.
TL323 *Spraying Systems Co.

Nozzles, Spray.....Announces new type of hydraulic spray nozzle. Spraying may be indexed to requirements of any production spraying operation where intermittent spraying is needed. Request Data Sheets 6125 & 6240.
436D Spraying Systems Co.

* See explanation on p. 420

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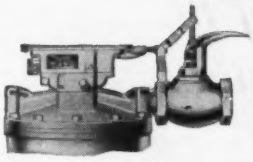

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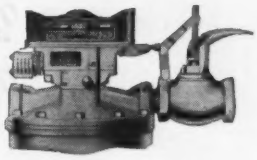

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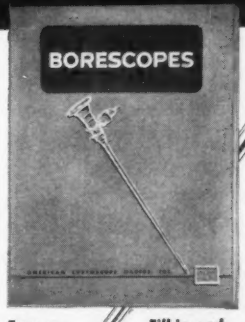

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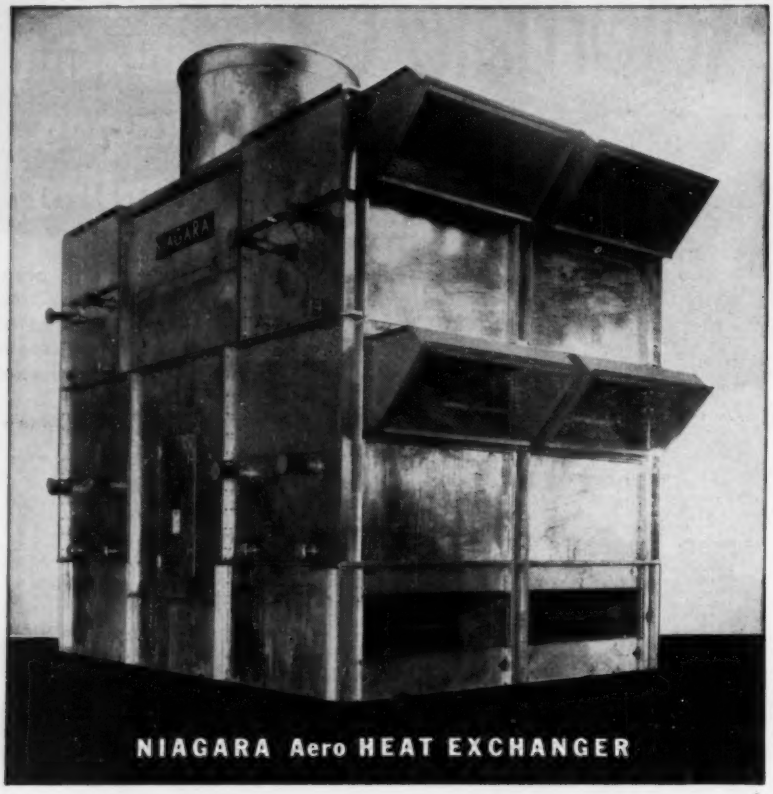

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LITERATURE . . .

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353b *National Carbon Co.

Pipe & Fittings, Glass.....Glass pipe & fittings for full-scale production operations. Strengthened by end-tempering & feature corrosion-resistance, non-contamination, etc. Catalogs EA-1 & EA-3 offer full data.
226-7a *Corning Glass Wks.

Pipe Installation, Glass.....Pipe is easy to install & low in installed cost compared with other corrision-resistant materials. Available in 6 standard sizes from 1- to 6-inch. I.D. inclusive. Installation Manual PE-3.
226-7b *Corning Glass Wks.

Tubing, Metal, Flexible.....Fully illustrated 52 p. reference offers valuable information on Titeflex helically-wound flexible metal tubing and Uniflex helically-corrugated flexible metal tubing. Catalogue 200.
438A Titeflex, Inc.

Unions, Stainless Steel.....Comprehensive illustrated literature on stainless steel unions specifically designed and constructed for top performance on all metering, measuring and flow control services.
BL435 *Clayton Mark & Co.

Valve Parts.....Threading Stainless Steel—a 4 p. Folder describes specific high production machining operations on stainless steel valve parts. Speeds, cutting angles, coolants and tooling are discussed.
364f *Cooper Alloy Corp.

Valves.....8 p. Folder gives data needed to enable manufacturer, supply company or sales representative to fit the proper valve for the application. Tells buyer how to get what he needs when ordering a valve.
364e Cooper Alloy Corp.

Valves.....Valves to Combat Corrosion . . . literature presents 75 questions and answers selected from Cooper Alloy valve clinics covering materials, operations, service problems, installation and repair.
364q *Cooper Alloy Corp.

Valves, Bronze.....Covers OIC 500 line —modern 200 lb. bronze valves. Includes features, service recommendations, working pressures, etc. for globe & angle valves—horizontal & angle checks. Form No. 1001.
39 *Ohio Injector Co.

Valves, Butterfly.....Issues reference describing tight-closing rubber-seated butterfly valves (Model BV). Includes data on valve operators, butterfly valve components, sizes, pressures & velocities. Bulletin 650-L1A.
438B Builders-Providence.

Valves, Cast Flanged.....Standard Practice SP-42 . . . 8 p. Folder listing detailed specifications for 150# corrosion-resistant cast flanged valves, flanges and flanged fittings. Copies available upon request.
364a *Cooper Alloy Corp.

Valves, Check.....When used with tanks, dry cans, retorts & pressure vessels of all kinds, the Durabla check valve unit is the lowest cost, high-quality valve you can purchase. Full details in Bulletin P-1.
421 *Durabla Mfg. Co.

Valves, Chlorine.....Now regularly available with screwed ends & flanged ends . . . designed exclusively for water-free chlorine gas or liquid up to 300°F. For full information, request Folder No. AD 1976.
249 *Crane Co.

Valves, Gate.....Feature properly designed, accurately finished seating of 18-8 SMo stainless steel—plus the extra erosion-corrosion resistance of Ni-Resist bodies & bonnets cast by Crane. Folder AD2047.
293 *Crane Co.

* See explanation on p. 420

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Valves, Gate & Globe.....Design Factors of Stainless Steel Valves . . . offers a 4 p. Technical Folder explaining basic design factors which a good stainless steel gate or globe valve should incorporate.
364j *Cooper Alloy Corp.

Valves, Lubricated Plug.....New manual covers lubricants for ACF plug valves. Profusely illustrated, it features cross sectional views of ACF valves & goes into detail regarding construction. Lube Manual No. 3.
439A ACF Industries.

Valves, Pinch-Type.....Company announces a new line of flanged valves for handling corrosive materials or abrasive slurries wet or dry. For details on features and advantages, request illustrated Catalog 1154.
439B R. K. L. Valve & Mfg. Co.

Valves, Plug.....ACF valves are backed up by proof-of-performance in every processing industry. Descriptive reference furnishes complete information on the entire valve line. Request illustrated Catalog E-8.
73 *ACF Industries

Valves, Porcelain.....Company makes available detailed literature covering the features and advantages of porcelain valves. Bulletin includes complete description, characteristics and specifications of product line.
211 *Lapp Insulator Co.

Valves, Solenoid.....A new automatic valve to solve your tank or drum filling problems . . . the Davis No. 97th solenoid valve—saves time, avoids waste, promotes safety. Makes available descriptive literature.
L389 *Davis Regulator Co.

Valves, Stainless Steel.....Flow Diagrams . . . valuable Folder describes basic stainless steel valve designs in terms of fluid flow. The uses and limitations of each major type are discussed. 4 p.
364b *Cooper Alloy Corp.

Valves, Stainless Steel.....Announces availability of a 68 p. simplified stainless steel valve catalog which includes engineering drawings, wts., size ranges, dimensions & basic material data. Catalog No. 55D.
364h *Cooper Alloy Corp.

Valves, Stainless Steel.....Jenkins Stainless Steel Valve Booklet illustrates and describes wide range of globe, gate, check and Y valves, includes selection data, survey forms. Request Form No. 200-A.
61 *Jenkins Bros.

Valves, Stainless Steel.....Valve Technical Data . . . announces the release of a 12 p. Technical Manual which furnishes design, selection, maintenance and repair information for stainless steel valves.
364k *Cooper Alloy Corp.

Valves, Stainless Steel.....Figure Number Cross Reference Chart . . . supplies descriptive literature—a 4 p. Folder which shows equivalent figure numbers of the five leading stainless steel valve producers.
364l *Cooper Alloy Corp.

Valves, Stainless Steel.....Getting the Most Out of Your Valves . . . provides a detailed, 4 p. technical discussion explaining selection, installation, inspection and maintenance of stainless steel valves.
364m *Cooper Alloy Corp.

* See explanation on p. 420

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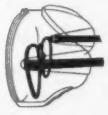
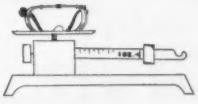
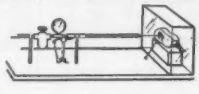
Wearing comfort
Channeled sides of frame give comfortable clearance over spectacle temples.



Light in weight
Can be worn all day without fatigue—encourage continuous protection.



Impact resistance
Pass recognized tests for impact protection as listed in Federal Specification GGG-G-531a, Goggles and Spectacles, all plastic, industrial.



Workers who wear prescription glasses—even big plastic frames—are mighty glad to get the extra roominess provided by NO. 90A MONOGOGGLES. Its greater clearance results in utmost comfort.

Exclusive Willson features described at left encourage workers to wear these sturdy MonoGoggles. Note how large flat .060 plastic lens provides "picture-window" scope of vision—how the deep, transparent light green frame admits side vision while eliminating glare.

Ask your Willson distributor to demonstrate its unique protection against light impact hazards like those found in spot welding, buffing, woodworking and chemical handling. You have a choice of ventilated or non-ventilated frames, clear or green plastic lenses. Bulletin mailed promptly on request.

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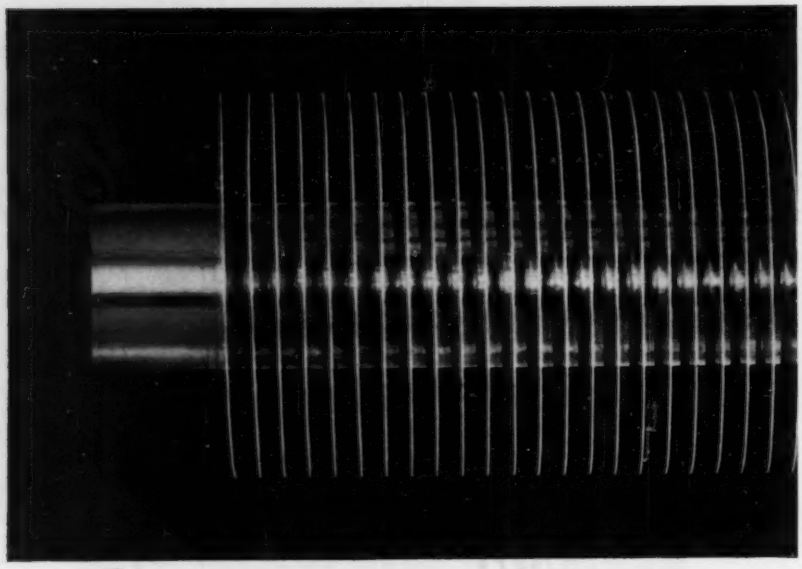

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offer you

Greater Heat Transfer
per sq. ft. of face area

Lower Airway Resistance
—less power per c.f.m.

Aerofin smooth fins can be spaced as closely as 14 per inch with low air friction. Consequently, the heat-exchange capacity per square foot of face area is extremely high, and the use of high air velocities entirely practical. Tapered fin construction provides ample tube-contact surface so that the entire fin becomes effective transfer surface. Standardized encased units arranged for simple, quick, economical installation.

AEROFIN CORPORATION

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Aerofin is sold only by manufacturers of fan system apparatus. List on request.

LITERATURE . . .

Valves, Stainless Steel.....8 p. Technical Article covers alloys, valve selection, design factors, installation, maintenance, operation and inspection of valves and fittings used by the paper industry.
364p *Cooper Alloy Corp.

Process Equipment

Absorbers.....For absorption of hydrogen chloride and other gases. Produce as much as 20 tons per day 22° Baume acid. Pneumatic automatic control. Complete information offered in Catalog No. S-7460.
353f *National Carbon Co.

Blending Systems.....Blend two or more liquids in preset proportions, automatically, in closed, continuous production. Feature highest possible accuracy. For complete information, request the "Blending" Folder.
TR437 *Bowser, Inc.

Centrifuges.....High speed dehydrating centrifuge offers precise external control of variations in flow rate, crystal size & slurry concentration & permits intermediate treatment of crystals. Bulletin No. 1257.
125 *Sharples Corp.

Classification Units.....Illustrated, 8 p. describes the historical development, physical characteristics, capacities and ranges of separation of newly designed classification unit. Request Bulletin No. 2503.
440A Dorr-Oliver, Inc.

Classifiers, Air.....The Hardinge Gyrotor Classifier system, combined with a Hardinge grinding mill is an integrated grinding, classifying & product conveying system. Details in Bulletin No. AH-467-11.
441 *Hardinge Co.

Cleaners, Floor.....Describes in detail outstanding features & advantages of Floormobile for suction cleaning (instead of sweeping) dust, dirt, lint, trash, etc. from large floor areas. Illustrated Bulletin No. 551.
440B Handling Devices Co.

Closing Devices.....New Sperry Handraulic closing device—easiest to install & operate—brings filtration economy to new or existing filter presses. Booklet covers simple erection & operating directions.
282 *D. R. Sperry & Co.

Crushers, Jaw.....Illustrated, 24 p. booklet offers complete information on company's line of jaw crushers. Built in eight sizes with capacities up to 300 tons per hour. Details available in Bulletin No. 1124.
21b *Traylor Engrg. & Mfg. Co.

Crushers, Jaw.....Multi-layer frame construction makes Lippmann "Rock-Ram" a stronger, lighter weight, lower cost jaw crusher with a high productive capacity. Details of features in illustrated Bulletin No. 1111.
440C Lippmann Engrg. Wks.

Crushers, Toothed Roll.....New booklet describes crusher line—tells how to get rid of obsolete manual crushing methods on miscellaneous chemicals ranging from wax-like material to very hard substances.
R447 *Franklin P. Miller & Son.

Deaerators.....Covers special features incorporated in latest jet atomizing deaerator development & emphasizes operational advantages to be gained from corrosion-resistant equipment of this type. Bulletin No. 102.
440D L. A. Water Softener Co.

Dehydrators.....Selas Dehydrator continuously dries compressed air, carbon monoxide, carbon dioxide, hydrogen, oxygen, gaseous hydrocarbons and inert gases. Contains full information in Bulletin No. SC-1013.
99a *Selas Corp. of America.

* See explanation on p. 420

Demineralizers.....Cochrane demineralizer installations have been providing continuous protection for years in many outstanding nigh pressure power plants in public utility & industrial fields. Bulletin 5800-B.
373 *Cochrane Corp.

Dryers.....Equipment provides control & flexibility essential to profitable drying performance. Many wet-solid materials previously unsuited to conveyor drying can now be handled efficiently. Bulletin No. 390.
430 *Proctor & Schwartz.

Dryers.....For solids drying...mechanical McNally Dryclone separates at low cost. Here is high drying efficiency, with drying costs held to a few cents per ton. Request descriptive Drying Bulletins.
420 *McNally Pittsburg Mfg. Corp.

Dryers.....Lectro-dryers can dry air & gases in volume to dewpoints below —100°F—can drop relative humidity lower than 10%. Booklet describes machines & how various industries use them to gain efficiency.
348 *Pittsburgh Lectrodryer Corp.

Dryers, Rotary.....Deliver top production, exacting performance, greater profits. Tells how Standard-Hersey has aided manufacturers throughout the world in solving their dryer problems, in illustrated, 12 p.
374 *Standard Steel Corp.

Dryers, Rotary Vacuum.....Company announces the availability of literature on their vacuum drying equipment (Catalog No. 720) and a new reference covering Stokes Laboratory facilities (Bulletin No. 640).
153 *F. J. Stokes Mach. Co.

Dust Collectors.....In almost every type of industry . . . users have found high efficiency, simplicity & economy of Dustube collectors a difficult combination to equal for top performance. Details in Bulletin 372.
346 *American Wheelabrator.

Dust Collectors.....For extremely fine dust or dust that must be reclaimed dry . . . add up the advantages of Amerjet: outstanding performance; lower service cost; smaller space requirements. Bulletin 279.
129 *American Air Filter Co.

Dust Control.....The Roto-Clone Dust Control Manual makes liberal use of photographic reproductions to tell a complete story, in words & picture, of modern method of controlling process dust. Request Bulletin 270.
441A American Air Filter Co.

Dust Control.....Company line of dust control equipment performs the vital service of product recovery and dust control in the numerous material processing operations. Offers complete descriptive literature.
434 *Ducon Co.

Dust Control.....Dust control equipment solves the problem of collecting valuable dusts—or controlling harmful dusts. Company makes available complete technical information in their 40 p. Bulletin No. 800.
14 *Dracco Corp.

Dust Control.....Pangborn engineers help solve your dust problems—line of wet or dry dust collectors can save time, trouble & money. See how varied industries are benefited in "Out of the Realm of Dust."
297 *Pangborn Corp.

Dust Filters.....Help solve dust control problems. Describes the numerous advantages of using the Day line of high pressure reverse jet filters . . . for efficient dust control. Illustrated Bulletin No. 528-R.
362 *Day Co.

Ejectors, Steam Jet..... Company's line of steam jet ejectors are available in single or multi-stage, with condensers as required. Provides details on advantages and performance in informative Bulletins.
412 *Elliott Co.

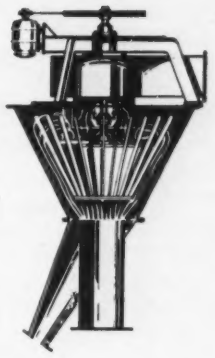
* See explanation on p. 420

change from...

40 MESH

to

400 MESH



. . . in a few minutes, without interrupting operations. Yet any desired mesh may be maintained continuously. Ease of adjustment and close product control are possible with the . . .

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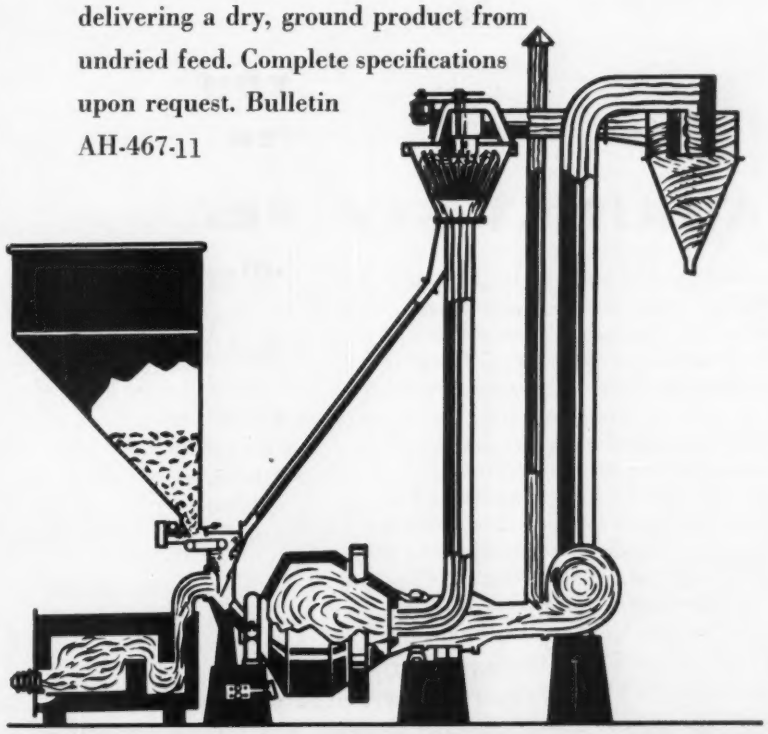

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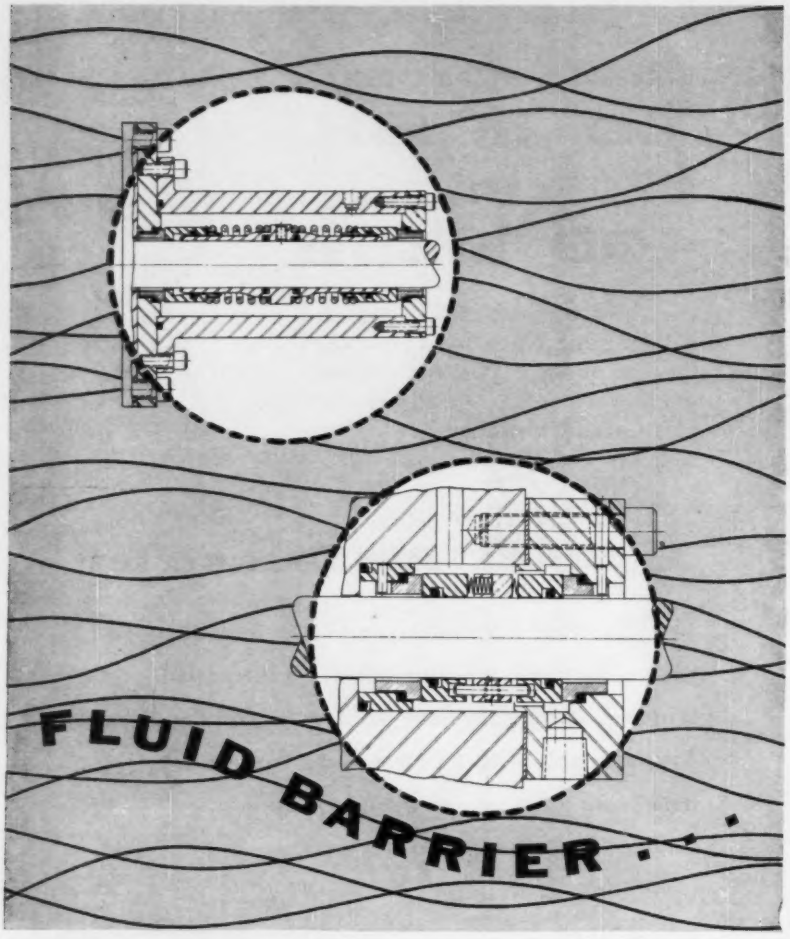

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Sealol Fluid Barrier Double Seal now permits positive sealing of rotary shafts against corrosive, abrasive, or gum-forming liquids. This type of seal — with barrier fluid between double Sealol Seals, or double Flexibox Seals — is now serving effectively on pumps, agitators, and many other pressurized process applications.

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LITERATURE . . .

Film Slitters, Plastic.....Presents fully illustrated Bulletin describing the new Slit-Go, Model No. 2500...a precision-built slitter-rewinder, designed for speed, dependability, and economy of operation. 4 p.
442A Slit-Go, Inc.

Filter Cloth, Metallic.....Newark metallic filter cloth is available in a variety of weaves in all malleable metals, and is adaptable to practically all types of filters. Complete data in new Catalog "E."
428 *Newark Wire Cloth Co.

Filters.....Efficient filtration is a critical process requirement in electrolytic preparation of hydrogen peroxide. Adams filters with inert Poro-Stone media where chosen with good results. Bulletin 431.
223 *R. P. Adams Co.

Filters, Air.....Covers line of Poro-Stone filters for compressed air & gases. Filters give you: increased production; longer tool life; less maintenance; easy cleaning; etc. Illustrated Bulletin No. 117.
442B R. P. Adams Co.

Filters, Millipore.....Covers the Millipore Filter...the all-purpose filter designed for & proved in the atomic energy field. Describes the filter as a monitoring device—as a research tool. Illustrated.
442C Millipore Filter Corp.

Filters, Pressure.....Covers high capacity, high efficiency, horizontal tank, vertical leaf filter designed for maximum ease & speed of operation at lowest operating & maintenance cost. Bulletin PF-2-55-5M.
6 *Bird Mach. Co.

Filters, Pressure Leaf.....For flow rates two to five times greater than cloth covered presses; positive removal of all suspended solids to desired degree of clarity; etc. Find complete details in Catalog No. NC-1-53.
292 *Niagara Filters Div.

Impactors.....Offer lowest possible cost-per-ton in producing top quality materials from 2" down to 35 mesh with a minimum of fines—or much smaller where more friable products are handled. Detailed literature.
101 *Williams Patent Crusher.

Jet Apparatus.....Includes basic information on jet principle, jet apparatus terminology, and data on jet construction, operation and advantages offered by jet apparatus. 12 p. illustrated Bulletin No. J-1.
331 *Schutte & Koerting Co.

Kilns, Rotary.....Efficient thermo-processing of products. Used in the production of lime, bauxite, cement, sodium silicate, alumina, etc. Complete data on design features offered in illustrated Bulletin 1115.
21a Traylor Engrg. & Mfg. Co.

Laboratory Equipment.....Investigate Sturtevant equipment for your laboratories. They will help you cut sampling cost—improve product quality—increase sales. For complete data, request illustrated Catalog.
150a *Sturtevant Mill Co.

Mills, Ball & Pebble.....Valuable references give complete details on the Abbé Engineering series of mills for every range of work from small batch jobs to full scale plant production. Catalogs Nos. 73 & 77.
R388 Abbé Engrg. Co.

Mills, Colloid.....Operate at speeds approaching the theoretical minimum required for true wet micro grinding —shaft speeds up to 10,000 rpm depending on size and type of mill. Offers descriptive literature.
TL435 *Admiral Tool & Mfg. Co.

Mills, Grinding.....Mills applicable for wet or dry, coarse or fine grinding. Assure a uniform product of desired fineness. Improved design and construction features fully described. Illustrated Bulletin No. 8121.
21C *Traylor Engrg. & Mfg. Co.

* See explanation on p. 420

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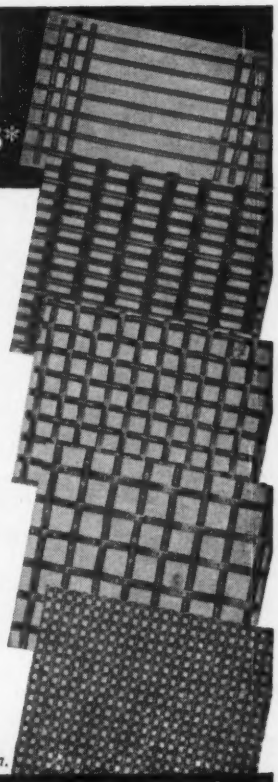

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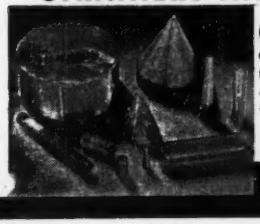

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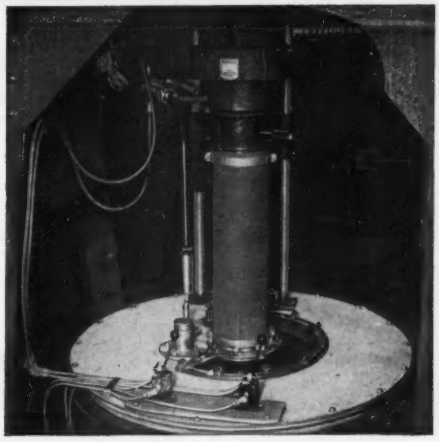

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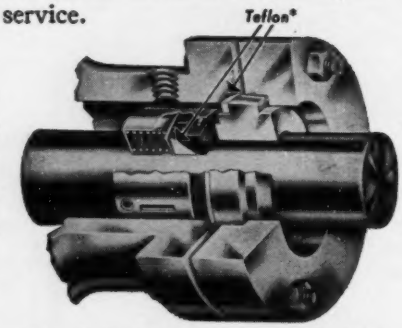

Your toughest problem can be the Type 9's next success story. Use it on all rotating shaft applications, including: centrifugal, rotary pumps, mixers, agitators, autoclaves, other equipment.

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JOHN CRANE CRANE PACKING COMPANY

LITERATURE . . .

Mills, Vertical.....Scale new heights in superfine grinding. Outstanding development is a specialized grinding unit designed to operate in a fineness range beyond limits of ordinary pulverizers. Catalog No. 70.
294 *Raymond Div.

Mixers.....Company makes available Confidential Mixing Data Sheet. Helpful checklist enables you to develop a complete technical description of agitation required for your process, quickly & easily. No. B-107.
121a *Mixing Equipment Co.

Mixers.....Data on turbine & slow speed heavy duty agitators . . . for open & closed tanks. Covers operation & applications of super-turbine & injection mixers, mixer data, mixer drive heads, etc. Bulletin No. 76.
345a *International Engrg.

Mixers, Pony.....The exceptionally rugged, heavy duty design characteristics of the Day pony mixers enables you to mix a stiffer, heavier paste, resulting in many advantages. Details in Bulletin No. 500.
320 *J. H. Day Co.

Mixers, Portable.....Use in industry reduces costs, saves time, labor and secures better and more refined products. Catalog includes data on construction, dimensions, specifications, etc. 28 p. No. B-108.
121b *Mixing Equipment Co.

Mixers, Portable.....Includes information on the numerous features and advantages, materials of construction, sizes and specifications, portable-permanent mountings, etc., in illustrated Bulletin 74-A.
345b *International Engrg.

Mixers, Side Entering.....Furnishes detailed information on features, typical applications, mechanical design, maintenance, shaft seals, methods of installation, etc., in completely illustrated Catalog B-104.
121f *Mixing Equipment Co.

Mixers, Side Entering.....The Type "NU" side entrance mixer is a brand new unique mixer design. It has no cast parts and is of all welded construction, including the stuffing box. Illustrated Bulletin No. 72-A.
345c *International Engrg.

Mixers, Top Entering.....Illustrated and detailed 32 p. Catalog includes advantages, typical installations, mechanical description, construction information, dimensions and selection tables, etc. Catalog No. B-102.
121c *Mixing Equipment Co.

Mixers, Top Entering.....Information on top entering propeller mixers. Includes data on selection, construction features, sizes & specifications of high & slow speed top entrance mixers, etc. Bulletin No. 73.
345d *International Engrg.

Mixers, Top Entering.....Makes available pertinent information on top-entering mixers (propeller type) . . . for closed tanks, pressure & vacuum . . . for open & loose-covered tanks. Data in Catalog B-103.
121d *Mixing Equipment Co.

Presses, Filter.....Offer numerous features: lowest cost per sq. ft. of filtering area; produce perfect clarity of filtrate; can be used in decolorizing—deodorizing; etc. Request Shriver Filtration Book.
411a *T. Shriver & Co.

Process Systems..... Allis-Chalmers process system converts fine particles into granular product to meet consumer demand. For complete information, company offers a detailed reference, Bulletin No. 25C6177J.
287 *Allis-Chalmers Mfg. Co.

Processing, Air-Gas.....The Selas Liqui-Jector continuously removes water, water-oil emulsions and dirt particles from air, gas and steam. For complete information on features request Bulletin No. SC-1007.
99b *Selas Corp. of America.

* See explanation on p. 420

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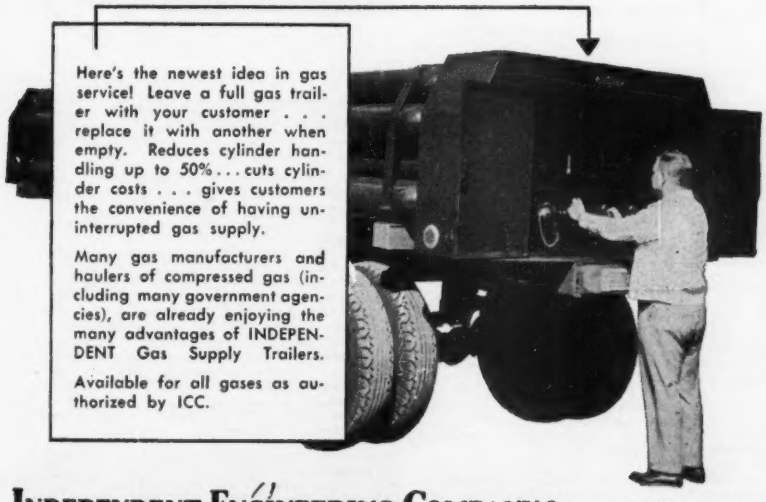

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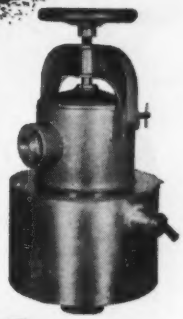

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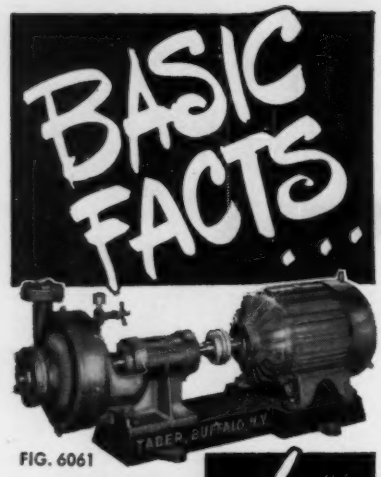

FIG. 6061

Fig. 19,488

for DECIDING ON TYPE OF PUMP; Write for TABER BULLETIN S-146

Practical GUIDE TO PUMP SELECTION

Big illustrations and brief descriptions with capacities and adaptability of pumps are contained in this unbiased compilation of facts to help avoid costly mis-application. Bulletin S-146.

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S-777

TABER

LITERATURE . . .

Pulverizers.....Valuable data on Superfine pulverizer . . . a centrifugal air attrition impact pulverizer and classifier in a single unit. Covers numerous features, specifications, construction, etc. Illustrated.
43 *Schutz-O'Neill Co.

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285 *Denver Equipment Co.

Sampling Systems, Gas.....The new Hays Gaspirator System is designed especially for difficult gas sampling problems involving high dust loading and high temperatures. Full details in Bulletin No. 55-829-56.
81b *Hays Corp.

Screens, Vibrating.....Data on Straightline—a horizonal vibrating screen of new design. Especially suited for dewatering high capacity loads & sizing of material where headroom is limited. Data Sheet No. 2562.
446A Link-Belt Co.

Screens, Wire.....Wire screens for vibrators are serving faithfully in daily operations in the major coal and mining centers of the world. Offers complete information on product line in Bulletins Nos. 5, 6, and 7.
TL443a *Cleveland Wire Cloth & Mfg.

Separating & Sizing Machinery.....If you process granular materials that must be uniform in length, width, or thickness, Hart-Carter sizing machinery may be what you need. Details in Folders CPG-2 and L-1.
R329 *Hart-Carter Co.

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446B Southwestern Engrg. Co.

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298 *Fritz W. Glitsch & Sons.

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413 *Cambridge Wire Cloth Co.

Pumps, Blowers, Compressors

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66 *Carrier Corp.

Compressors, Balanced/Opposed..... Illustrated, 36 p. describes 300-10,000 hp balanced/opposed compressors—basic principles, drive, design, running gear, lubrication, capabilities, etc. Bulletin L-679-B1.
78-9 *Worthington Corp.

Exhausters.....Complete data on General steel plate exhausters—capacity tables, dimensions, directions of rotation & discharge, standard drive arrangements & engineering design data. 24 p. Bulletin MX-104R.
446C General Blower Co.

* See explanation on p. 420

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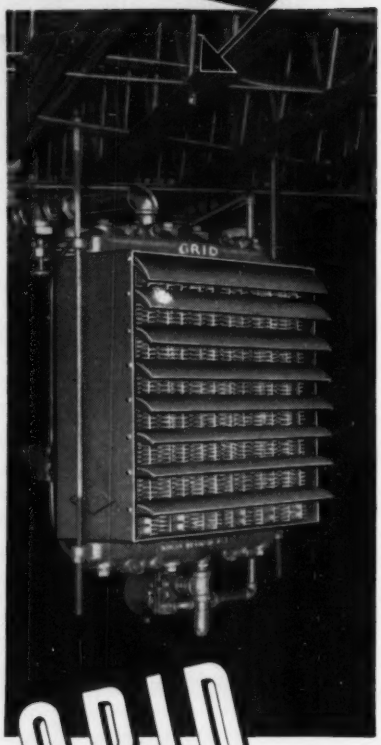

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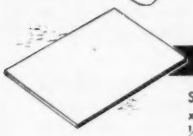

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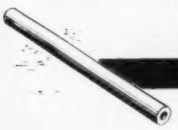

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447B General Blower Co.

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345e *International Engrg.

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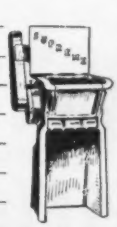

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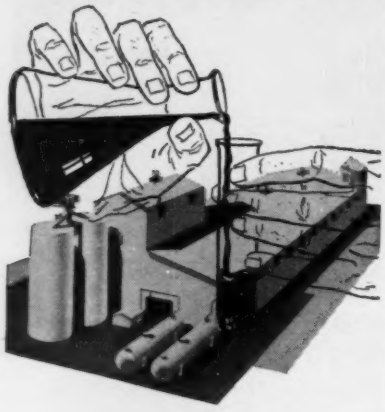

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Pumps, Rotary Screw.....Catalog LS gives useful application & specification data on IMO pumps & article, "Rotary Pumps, Basic Considerations in Their Application," describes rotary pumps in general.
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449F National Safety Council.

Vents, Non-Conservation.....Storage tank installation at eastern by-product benzol plant combines: maximum airflow capacities; positive fire protection; low-cost maintenance. Request "Venting Fundamentals."
R449 *Protectoseal Co.

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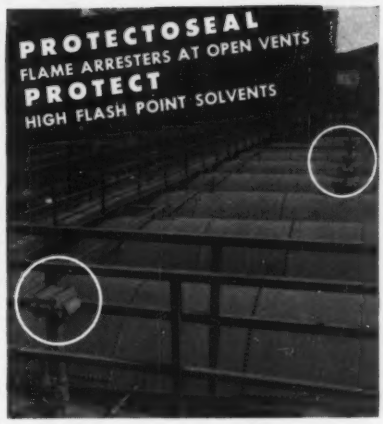

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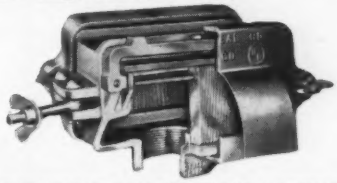

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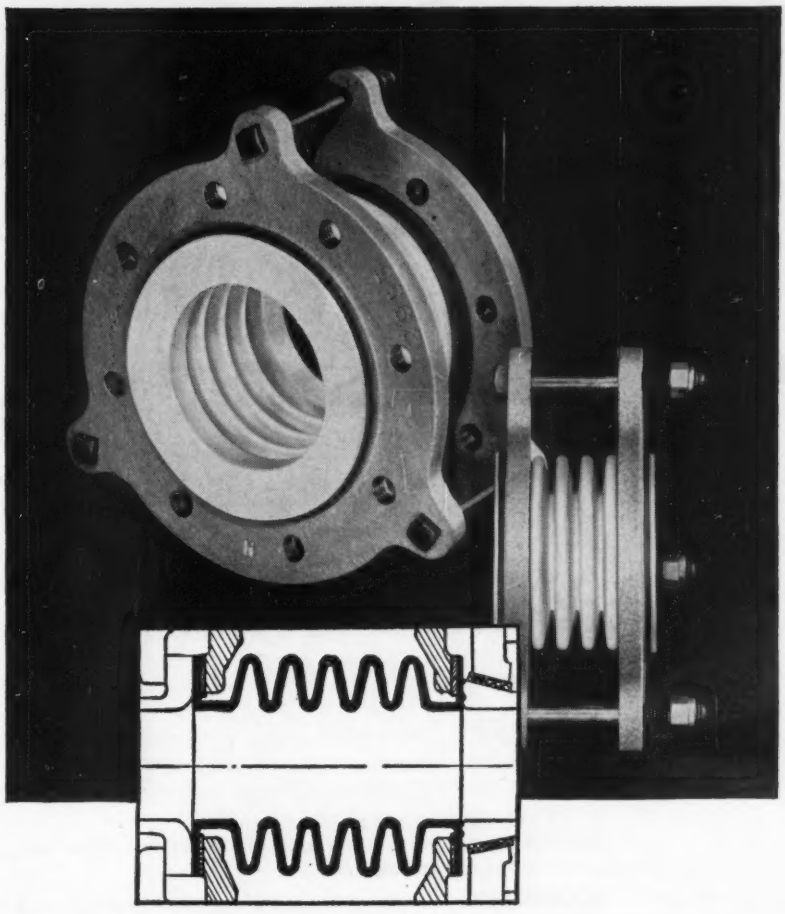

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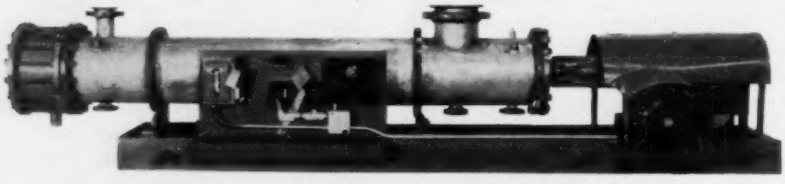

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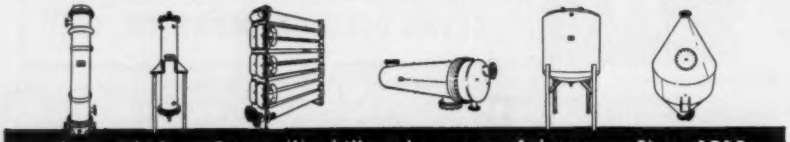

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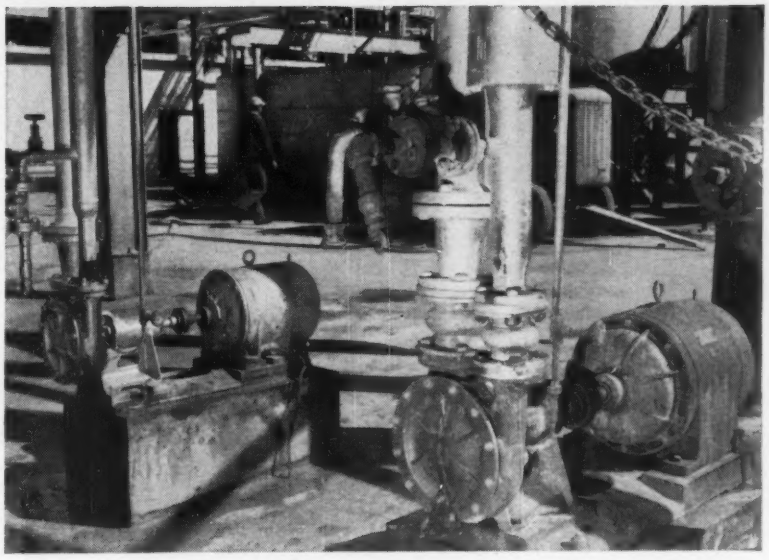

These Fig. 3705 Goulds stainless steel pumps move hot sulphate (50° C.) and potassium chloride (40° C.) solutions with as high as 30% solids, at the Carlsbad, N. M. plant of the International Minerals and Chemical Corporation. The Fig. 3715 pump discussed below is an improved design of this pump.

No heartburn in these pumps as they move *hot, corrosive* and *abrasive* liquids

The sulphate and potassium chloride solutions handled at this plant would soon eat the heart out of an ordinary pump.

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They are available in Gould-A-Loy 20 stainless steels, all iron, all bronze, iron with stainless steel or bronze trim, and bronze with stainless steel trim. You can fit the pump to the job, obtain many long years of trouble free service.

Here are just a few of the other extra features you get:

1. You can move liquids at temperatures up to 350° F., because the pump has quenchable cowl-type glands and cooling chamber in the support head.

2. Stuffing box on suction side of impeller gets suction pressure only, holds leakage at a minimum.

3. You can change easily from conventional stuffing box to single or double mechanical seal.

4. You can inspect and clean the pump without disturbing piping connections.

These Goulds Fig. 3715 chemical pumps are available in nine sizes with capacities up to 720 GPM and heads, depending on capacity, up to 200 ft.

See all the special features of the Fig. 3715 pump in your own office. We've made an aluminum model which you can take apart on your desk. Just ask your Goulds representative to show it to you. Or, write to our main office and we'll make the arrangements.

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10% NaOH	0	6 hr.	72 hr.

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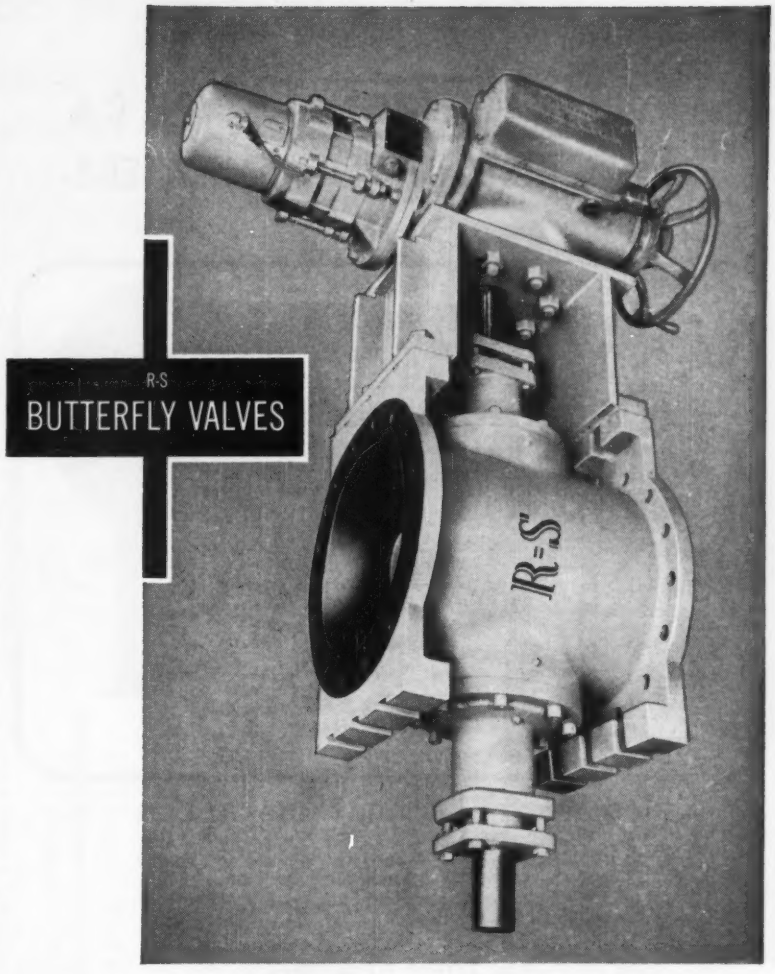

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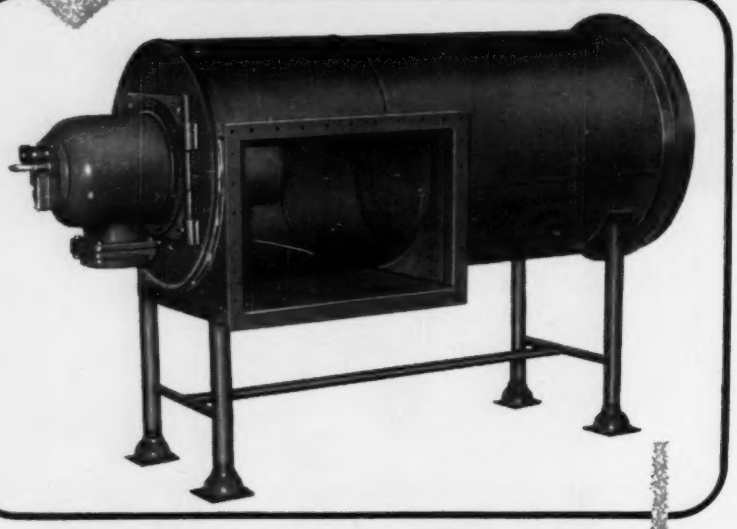

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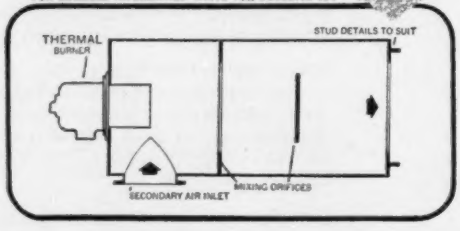

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21d	61	95	144B	226-7a	258C	299	BL327	346	364p	420C	424A	430A	438A	448D
21e	62a	96-7	145	226-7b	258D	300	R327	347	364q	420D	424B	430B	438B	448E
21f	62b	98	146A	229	260A	301	328	348	364r	420E	424C	430C	439	L449
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15	57c	89	140A	211	256D	286b	R323	345c	364h	414	422H	428C	436A	R447
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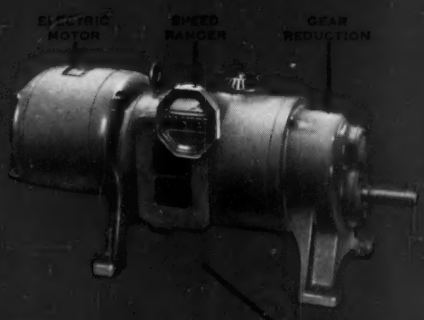

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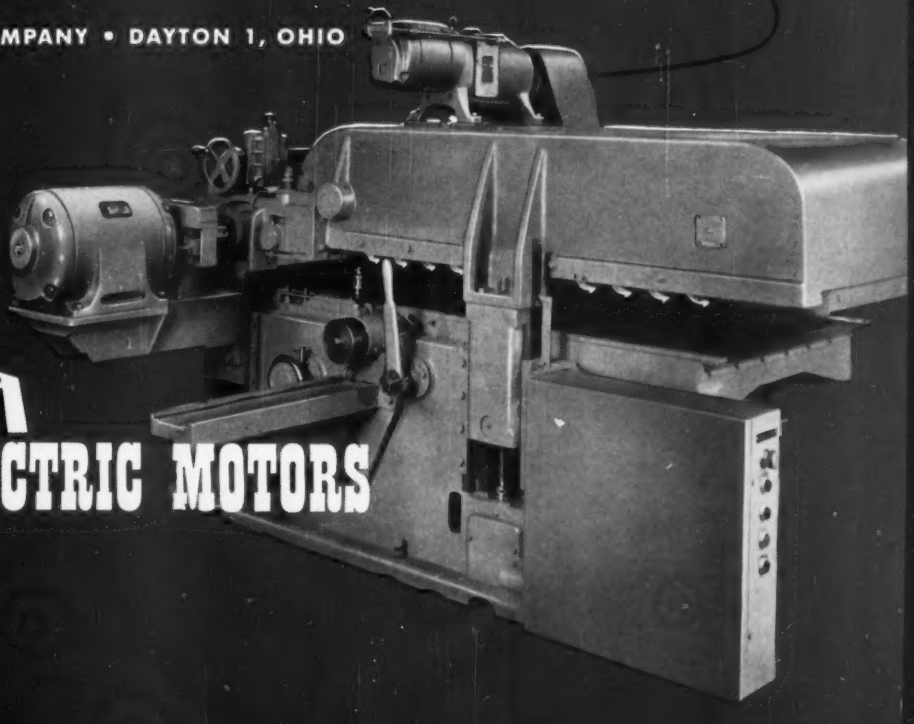

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Corrosioneering News

Quick facts about the services and equipment Pfaudler offers to help you reduce corrosion and processing cost.

These "extras" pay big dividends for Pfaudler customers

Besides bringing you the benefits of over 70 years' experience in the process equipment business, Pfaudler provides a number of extra activities to help increase the industry's knowledge of corrosioneering as a whole.

CORROSION FORUMS, held several times a year, provide a three-day conference on latest developments in processing equipment. Hosted by Pfaudler, the meetings spark a lively interchange of ideas among processing men.

MAINTENANCE CLASSES teach Pfaudler customer operating personnel the proper methods of upkeep for all types of equipment, helping to reduce maintenance time and costs.

RESEARCH LABORATORY keeps its doors open to everyone with corrosion problems. This may include pretesting your product in a laboratory model of a Pfaudler Unit, such as the new conical glassed steel dryer blender. Or it may mean sending you sample buttons of glassed steel for testing with your own product at your plant. Pfaudler research people are also frequently called upon to speak or write for the benefit of the chemical industries at large.

We mention these extras – only a small percentage of all the activities at Pfaudler – to point out that, while we pay our rent with the money we earn by building equipment, we devote a great deal of effort to study and research – making every effort to provide you with the most advanced developments in design, corrosion resistance and durability.

Corrosion Forums at Rochester provide liberal exchange of operating ideas plus a quick look at the future.

How to stop contamination when processing sticky products

A good example of a clinging product is polyvinyl chloride. It sticks to most everything. And when it forms a layer on the inside of an all-metal reactor, it creates a serious cleaning problem, because material left adhering to the walls will contaminate succeeding batches.

Another drawback often encountered in metal reactors is metallic contamination, which upsets the heat stability of the resin.

You can eliminate these two hazards with Pfaudler glassed steel polymerizers. Practically nothing sticks to their smooth inner surface. Cleaning is quick and easy.

And there is no metallic contamination. Pfaudler acid-alkali-resistant glass shrugs off attack by all acids except hydrofluoric, resists alkaline solutions up to pH 12 at 212° F. This provides a broad latitude of applications which can be served by this equipment.

Your Pfaudler representative will gladly discuss your own processing needs with you. Call him or write us.

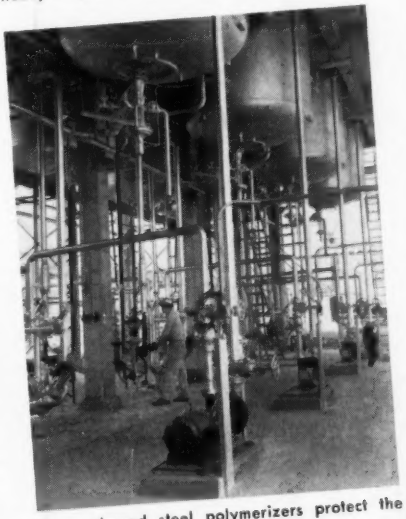
CUTAWAY VIEW of Pfaudler Glassed Steel Reactor shows two good reasons why it can easily handle sticky products: Smooth glass surface, plus a highly efficient, rigidly supported agitator which is capable of maintaining thick, heavy suspensions.

Glassed steel polymerizers at General Tire

These Pfaudler Reactors at General Tire and Rubber Co., Ashtabula, Ohio, process HCl with PVC, at pressures as high as 200 psi. Once started, this reaction becomes very exothermic, and accurate temperature control becomes a vital necessity. Because glass reduces filming on the reactor walls, closely controlled heat transfer is easily accomplished with minimum impedance.

Another important problem is protecting the product from contamination by lubricants, metal, or product which has remained from earlier batches. The corrosion resistance of Pfaudler Glassed Steel prevents metallic contamination and the smooth, nonadhering surface prevents accumulation of product.

These reactors are 3500-gallon units. Since ten of them were put into service in October 1954, the records show that they have maintained a very high level of product purity and quality, with regard to particle size and temperature of processing.



These glassed steel polymerizers protect the purity of PVC at General Tire.

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